

6. Water Supply Management

Chapter 6 discusses the dynamic strategy needed to meet Colorado's future water needs. This chapter describes the types of projects and methods needed and actions required to implement them. Scenario planning provides the framework for this, indicating what Colorado needs to accomplish in the short-term. Section 6.1 and Section 6.2 provide information needed to assess how close Colorado is to meeting this strategy and discuss the remaining municipal, industrial, agricultural, environmental, and recreational water gaps, and the methods by which basins propose to address them. While Colorado will need a variety of projects and methods to meet its current and future water needs, ranging from storage projects to riparian restoration, two avenues deserve special attention. Demand management strategies, such as conservation and reuse, will help address Colorado's growing demands while upholding our water values. Section 6.3 looks at various ways to use water efficiently and reduce water demands. Section 6.4 discusses opportunities to share water between agricultural and municipal or environmental and recreational interests. This is another important option that needs special attention if these alternative methods are going to be effective and help reduce the permanent dry-up of Colorado's irrigated lands. These sections, as well as Sections 6.5 and 6.6, provide a summary of projects, methods, and policies that the Basin Implementation Plans (BIPs) identified as necessary for meeting Colorado's future water needs. Planning for Colorado's water future presents many challenges and opportunities, and this chapter demonstrates the variety of ways that stakeholders at the state and local levels are collaborating to address these important issues.

6.1 Scenario Planning & Developing an Adaptive Water Strategy

Colorado's Water Plan considers a range of possible future conditions and develops a practical, adaptive, and balanced path forward for meeting Colorado's future water needs through public engagement and sound science.

The purpose of scenario planning is to develop strategies to meet Colorado's future water needs that are based on the best available science and input from stakeholders. Section 6.1 broadly describes what needs to be done to meet our future needs over the next ten to fifteen years and prepare for a broad range of possible futures. Scenario planning also provides the opportunity to consider Colorado's water values to build portfolios of solutions. Conservation, reuse, completion of planned projects, and development of alternative agricultural transfers are all needed in the near term. At the same time, Colorado must prepare for the possibility of further agricultural transfers, possibly an additional transmountain diversion (TMD) as described in Chapter 8, and even higher levels of conservation to meet future municipal and industrial (M&I) needs while concurrently implementing environmental and recreational projects and continuing to support agriculture.¹

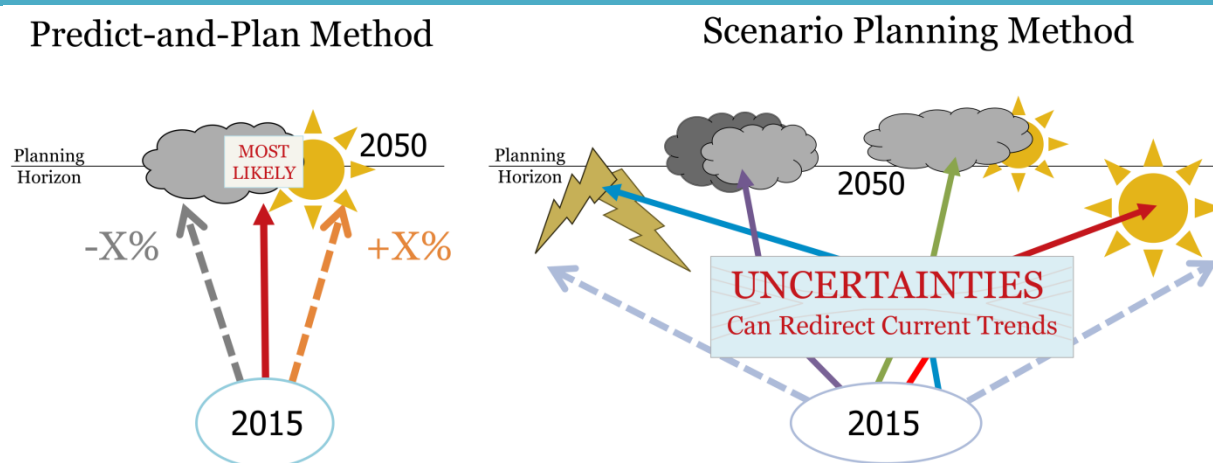
The elements of Colorado's adaptive strategy arose from significant technical work and the early and ongoing engagement of stakeholders. In developing Colorado's Water Plan and Statewide Water Supply Initiative (SWSI) 2016, the Colorado Water Conservation Board (CWCB), basin roundtables, and the Interbasin Compact Committee (IBCC) adopted the scenario planning process to initiate a conversation among stakeholders about planning for uncertainties and emerging water resource challenges.² These groups worked together to explore how to meet increasing water needs of growing communities while balancing water interests.³ Of particular concern, Colorado must contend with the significant and growing municipal water needs by 2050.⁴ Scenario planning helps answer how much water we may need in the future, how much water may be available to meet our future needs, and what sources of water supply future generations will support. The subsequent sections in Chapter 6, as well as Chapter 8, provide the detail for how we can more specifically respond to an uncertain future by employing the scenario planning approach.

Rather than trying to predict the future by looking at the past, scenario planning allows us to identify and account for key uncertainties

Scenario planning: *Planning for multiple futures*

Given the uncertainties of future water supply and demands, the CWCB adopted a planning approach used by many major water planners across the West: scenario planning.⁵ The use of scenario planning assumes that the future is unknown and provides flexibility in responding to various future conditions.⁶ Rather than trying to predict the future by looking at the past, scenario planning allows us to identify and account for key uncertainties operating within the planning period (see Figure 6.1-1).

Figure 6.1-1: The Traditional “Predict-and-Plan” Approach Compared to the Scenario-Planning Approach

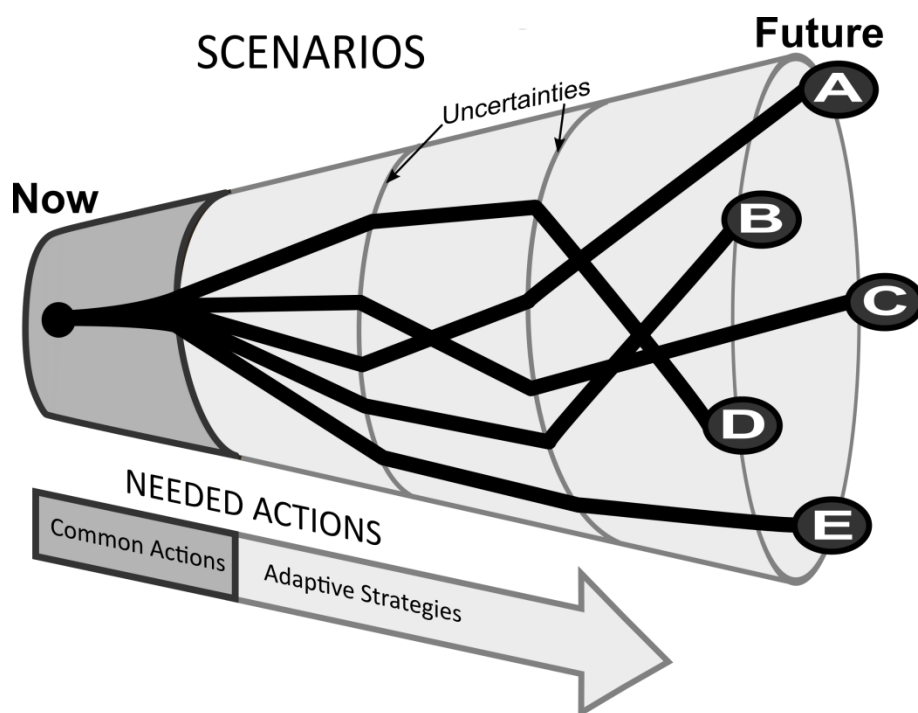


Adapted from Global Business Network, 2012 & Marra, 2013.⁷

Scenario planning relies on key driving forces to build multiple plausible futures (i.e. scenarios) rather than the most probable one, as is used to develop the more traditional “predict-and-plan” approach. The CWCB explored with stakeholders the implications of multiple plausible futures. Given the unpredictability of factors driving Colorado’s future, such as climate change, economic and population growth, and social values, the ability to plan for multiple scenarios presents a much more comprehensive tool to plan and prepare for Colorado’s future. Descriptions of several futures Colorado could face were developed and used to identify and evaluate a prospective series of implementable projects and initiatives called portfolios. One goal of this work was to identify projects and policies that occur on multiple pathways. These common actions would therefore apply to multiple futures and can be planned for and prioritized first while still monitoring uncertainties that can redirect recent trends.

By implementing successive sets of common actions over time, decision makers can have greater confidence that the policies and investments made in the near term will also be viable in the longer term. The near and longer term actions combine with the scenarios to create a forward-looking pathway of actions that both anticipate and prepare for the emerging needs of the future. Figure 6.1-2 conceptualizes how various future conditions can be aligned into near term actions and longer term adaptive strategies.

Figure 6.1-2: Scenario Planning Identifies Successive Sets of Common Actions that Apply to Multiple Futures

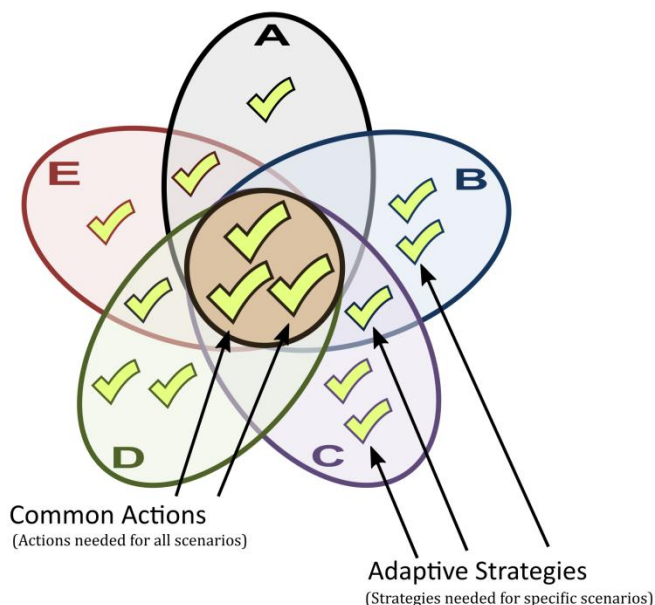


Adapted from Marra & Thomure, 2009.⁸

In the near term, our way forward is to implement actions common to all or most of the envisioned futures. These common actions have broad applicability, as is shown on Figure 6.1-3. The common

actions are needed no matter which scenario is eventually encountered and can be implemented immediately, whereas the adaptive strategies are dependent on the specific scenario and will be evaluated based on future information. In the mid-to-long term, the direction forward may narrow and favor a smaller set of possible futures. Planned actions and strategies would then be reevaluated and updated based on the status of predetermined “signposts” or decision points that help to reveal whether past uncertainties now have more clarity. For water in Colorado, these uncertainties include water needs, water supply, and Colorado’s social values. Use of scenarios enables planners to respond and adapt to still emerging issues and to explore the opportunities and challenges that each possible future presents without reducing options available going forward.⁹

Figure 6.1-3: Common Actions and Adaptive Strategies in Scenario Planning



Developing Alternative Water Supply Portfolios

The SWSI 2010 report introduced the “status quo portfolio”—a set of prospective water supply actions that would likely be required if the trajectories of current trends continue. The status quo is counter to Colorado’s Water Values, (presented in Chapter 1), leading to large quantities of water being transferred out of the agricultural sector to satisfy M&I water supply needs. This transfer would result in a substantial loss of agricultural lands and could cause potential harm to the environment and Colorado’s economy. Additional challenges with the status quo portfolio are discussed below. The general statewide consensus is that the status quo portfolio of actions, and the projected future it assumes, is not desirable for Colorado.¹⁰

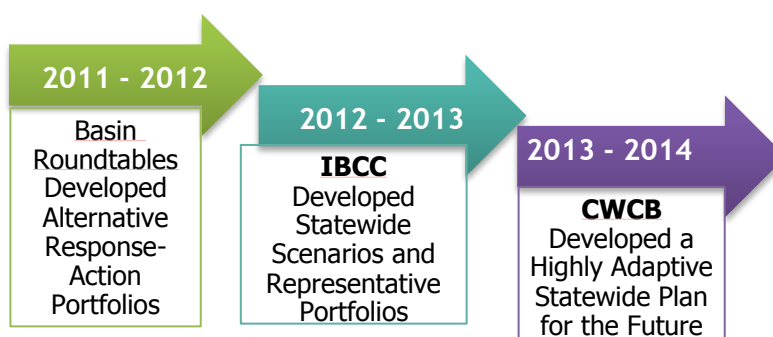
Given these concerns, the CWCB initiated a multi-year, stakeholder-plan development process with the nine basin roundtables and the IBCC. Each basin roundtable represents the water interests of a specific region within Colorado, and the IBCC facilitates conversations among the basin roundtables and addresses broader statewide water issues. The plan development process is summarized in Figure 6.1-4.

Each of the nine basin roundtables developed one or more statewide water-supply portfolios to respond to projected low, medium, or high future water needs for communities.¹¹ Each portfolio constitutes a unique combination of possible strategies that could be used to meet a range of projected M&I water needs. The strategies included conservation, reuse, agricultural transfers,

development of water projects within each basin, and transmountain water diversions. The CWCB developed an interactive tool that quantified tradeoffs associated with Colorado's Water Values that would result from each portfolio—effects on the environment, agriculture, reliability, and cost. This work brought basin roundtables together by showing how one water supply decision has multiple impacts across the state. Most of the 34 portfolios developed by the basin roundtables reduced these tradeoffs, thereby minimizing negative effects statewide and for each basin, and developed combinations of solutions that both met a variety of possible future conditions and aligned with Colorado's Water Values.

The IBCC subsequently synthesized and reduced the 34 basin roundtable-generated portfolios into a smaller set of ten “representative” portfolios, which addressed projected low, mid-range, and high M&I water demands (described in Chapter 5). The basin roundtables determined that the representative portfolios successfully captured the intent and character of the original 34 portfolios.

Figure 6.1-4: Summary of the Stakeholder and Plan Development Process



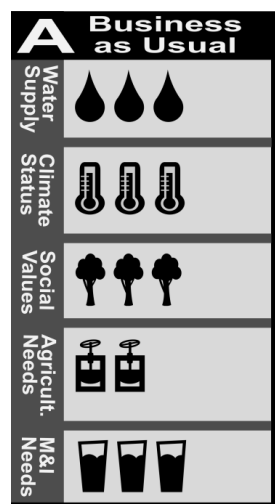
Formulating Plausible Scenarios

Potential changes in future M&I water demand and available water supply were among the most important drivers considered by all the basin roundtables when developing their portfolios. Some of the basin roundtables also considered changing societal values and other drivers outside the control of the water community. The IBCC took these perspectives into account when developing the list of nine high-impact drivers to factor into the scenario development process since these will greatly influence the direction of Colorado's water future:

1. Population/Economic Growth
2. Social/Environmental Values
3. Climate Change/Water Supply Availability
4. Urban Land Use/Urban Growth Patterns
5. Energy Economics/Water Demand
6. Level of Regulatory Oversight/Constraint
7. Agricultural Economics/Water Demand
8. M&I Water Demands
9. Availability of Water Efficient Technologies

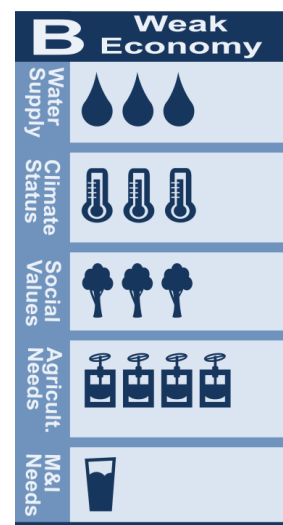
Using these drivers, the IBCC developed five scenarios that represent plausible futures, noted below, and matched them with five of the ten representative portfolios of solutions that best met the needs described in each scenario and aligned with Colorado's Water Values. The scenarios,

summarized below, represent how Colorado's water future might look in 2050 even though the actual future at that time will likely contain a mixture of multiple scenarios. The summary of the scenarios here also includes a visualization of the five of the main drivers listed above. The chart for each scenario shows the relative increase/decrease in levels from current levels (three out of five). The descriptive names given to the scenarios portray the overall essence embodied in their respective views of the future.¹² The IBCC described the scenarios as follows:

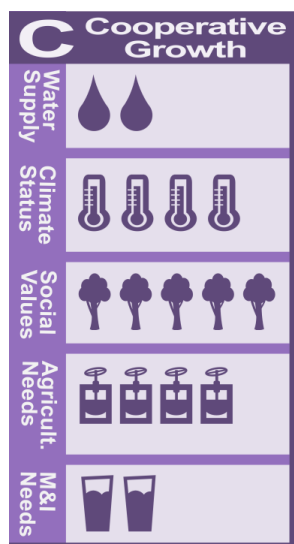


A. Business as Usual: Recent trends continue into the future. Few unanticipated events occur. The economy goes through regular economic cycles but grows over time. By 2050 Colorado's population is close to 9 million people. Single-family homes dominate, but there is a slow increase of denser developments in large urban areas. Social values and regulations remain the same, but stream flows and water supplies show increased stress. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation of new water development slowly increases. Municipal water conservation efforts slowly increase. Oil shale development continues to be researched as an option. Large portions of agricultural land around cities are developed by 2050. Transfer of water from agriculture to urban uses continues. Efforts to mitigate the effects of the transfers slowly increase. Agricultural economics continue to be viable but agricultural water use continues to decline. The climate is similar to the observed conditions of the 20th century.

B. Weak Economy: The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, slowing the conversion of agricultural land to housing. Maintaining infrastructure, including water facilities, becomes difficult to fund. Many sectors of the state's economy begin to struggle financially, including most users of water and water-dependent businesses. There is little change in social values, levels of water conservation, urban land-use patterns, and environmental regulations. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation decreases because of economic concerns. Greenhouse gas emissions do not



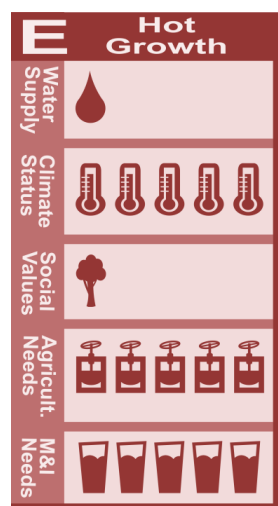
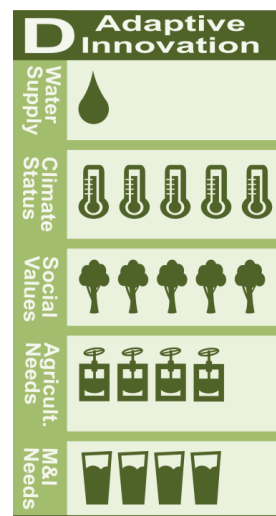
grow as much as currently projected and the climate is similar to the observed conditions of the 20th century.



C. Cooperative Growth: Environmental stewardship becomes the norm. Broad alliances form to provide for more integrated and efficient planning and development. Population growth is consistent with current forecasts. Mass transportation planning concentrates more development into urban centers and mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development. Coloradans embrace water and energy conservation. New water-saving technologies emerge. Eco-tourism

thrives. Water development controls are more restrictive and require high water-use efficiency along with environmental and recreational benefits. Environmental regulations are more protective and include efforts to re-operate water supply projects to reduce effects. Demand for more water-efficient foods reduces water use. There is a moderate warming of the climate, which results in increased water use in all sectors, affecting stream flows and supplies. This dynamic reinforces the social value of widespread water efficiency and increased environmental protection.

D. Adaptive Innovation: A much warmer climate causes major environmental problems globally and locally. Social attitudes shift to a shared responsibility to address problems. Technological innovation becomes the dominant solution. Strong investments in research lead to breakthrough efficiencies in the use of natural resources including water. Renewable and clean energy become dominant. Colorado is a research hub and has a strong economy. The relatively cooler weather in Colorado (because of its higher elevation) and high-tech job market causes population to grow faster than currently projected. The warmer climate increases demand for irrigation water in agriculture and municipal uses, but innovative technology mitigates the increased demand. The warmer climate reduces global food production, increasing the market for local agriculture and food imports to the state. More food is bought locally, increasing local food prices and reducing the loss of agricultural land to urban development. Higher water efficiency helps maintain stream flows even as water supplies decline. The regulations are well defined and permitting outcomes are predictable and expedited. The environment declines and shifts to warmer weather species. Droughts and floods become more extreme. More compact urban development occurs through innovation in mass transit.



E. Hot Growth: A vibrant economy fuels population growth and development throughout the state. Regulations are relaxed in favor of flexibility to promote and pursue business development. A much warmer global climate brings more people to Colorado with its relatively cooler climate. Families prefer low-density housing and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed. A hotter climate decreases global food production. Worldwide demand for agricultural products rises, greatly increasing food prices. Stream flows and water supplies decline. The environment degrades and shifts to warmer weather species. Droughts and floods become more extreme. Communities struggle unilaterally to provide the services needed for the rapid business and population growth. Fossil fuel is the dominant energy source, and there is large production of shale oil, coal, natural gas, and oil in the state.

The five scenarios collectively capture a broad range of future supply-and-demand possibility and uncertainty. Of the five scenarios, “Business as Usual” is the most conventional while “Adaptive Innovation” and “Hot Growth” are the most difficult to prepare for because of the high water demands combined with the effects of climate change. The challenge is not to pick the most likely or attractive future; rather, it is to develop the capacity to be prepared for all of them.

Developing an Adaptive Water-Management Plan

In analyzing the portfolios, the IBCC identified common near-term strategies and actions that would provide baseline benefits for all five of the envisioned scenarios. Most of these actions are necessary no matter what future Colorado faces and would fully meet low demands, as described in the weak economy scenario. Some strategies prepare Colorado for future projects and methods that may be needed in one or more futures. These near-term commonalities are called “no and low regret” strategies and actions since they would most likely be viable no matter how the future might ultimately unfold.

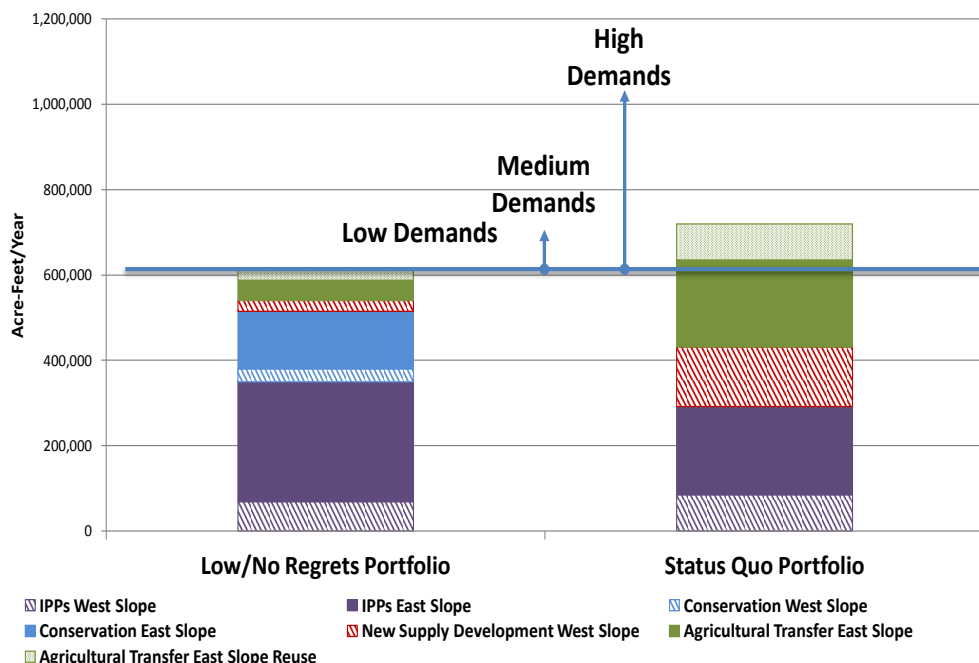
In this context, a “regret” is entering a future where there are either:

- 1) Water shortages because of an insufficient number of implemented necessary projects and methods,
- 2) Significant consequences to Colorado’s agriculture, environment, or economy because Colorado’s water community did not implement projects and methods consistent with Colorado’s water values, or
- 3) Too many unneeded and costly projects.

By implementing the no-and-low-regrets actions sooner rather than later, Colorado will be prepared for any future and at the same time not engender serious trade-offs.

Figure 6.1-4 shows how the no-and-low-regrets portfolio compares to the status quo.

Figure 6.1-5: No-and-Low-Regrets Portfolio versus the Status Quo Portfolio



The No-and-Low-Regrets Portfolio reduces potential effects to the environment and agriculture (compared to the Status Quo Portfolio) by increasing the success of planned projects and levels of water conservation. By doing so, the no-and-low-regrets portfolio is aligned with Colorado’s water

values and avoids the unacceptable consequences of continued drying up of Colorado's irrigated agriculture and using more Colorado River water. Nevertheless, the No-and-Low-Regrets Portfolio only meets the low-demand scenario (as shown on Figure 6.1-5) and additional water supplies or increased conservation will be needed if Colorado faces medium or high water demands. In addition, there are several portfolios that address higher demands while continuing to align with Colorado values, which are explored below.

The recommended no-and-low-regrets actions are described in more detail below, along with the adaptive strategies needed to prepare Colorado for other potential futures:

- **Minimize statewide agricultural acres transferred and implement agricultural sharing projects:** Limit traditional permanent dry-up of agricultural lands by supporting lower-impact alternatives for more than 300,000 people (50,000 acre-feet) in the near future. At the same time, track the reliability of these alternatives, and plan and preserve the option of additional agricultural transfers should a future scenario necessitate this action. These opportunities are described in Section 6.4.
- **Plan and preserve future options for developing unappropriated waters:** Develop additional water supplies from unappropriated water on the western slope for local use to serve a minimum of 200,000 people (35,000 acre-feet) and the associated jobs needed to support them in the near future. At the same time, plan for and preserve the option for an additional TMD, should a future scenario necessitate such a project through the conceptual agreement parameters described in Chapter 8.
- **Establish medium-high conservation strategies:** Implement strategies to meet medium-high levels of conservation and apply at least half of these savings to meet future M&I needs to support approximately 1 million people and the jobs needed to support them in the near future (200,000 acre-feet). At the same time, track the reliability of these conservation savings, and plan for how additional conservation savings could be achieved, should a future scenario necessitate this action. Section 6.3 describes several avenues for accomplishing this.
- **Implement projects and methods that support environmental and recreational uses:** Implement local projects, especially those that support imperiled species and recreational areas that are important to local economies. These projects and methods are described in Section 6.6.
- **Strive for high success rates for projects and methods that are already planned:** Work to support the projects that are already planned, as these already have a project proponent and are often smaller and less controversial than many of the other project options. Statewide, these projects may provide enough water for more than 2 million people and the associated jobs needed to support them in the near future (350,000 acre-feet). Continue to track the success rate of these projects and their ability to meet future community water needs. These projects and methods are further described in Section 6.5.
- **Assess and implement storage projects and other infrastructure:** Implement storage and other infrastructure to maximize flexibility and reliability. Focus on options that support multiple needs, such as for communities, agriculture, and the environment. Storage is further discussed as part of Section 6.5.

- **Implement water reuse strategies:** Implement strategies that encourage increased use of recycled water, as described in Section 6.3.

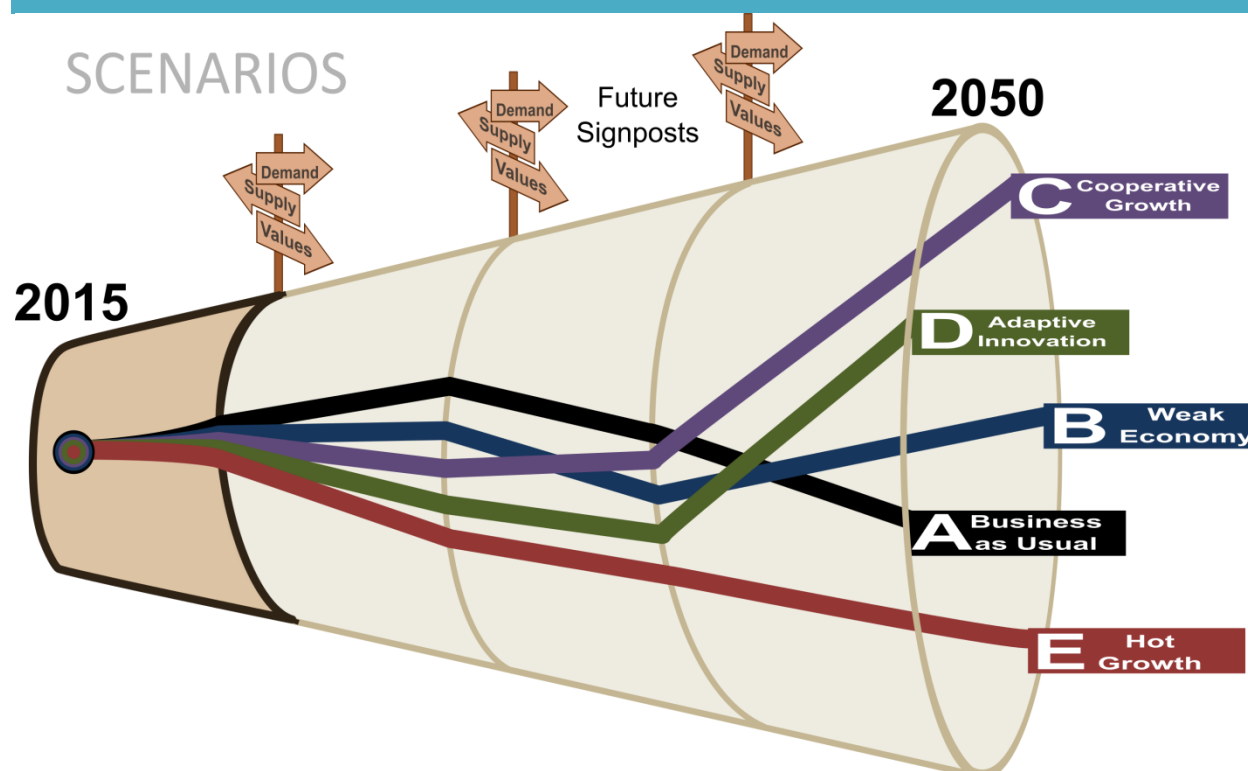
The no-and-low-regrets portfolio only satisfies the M&I water supply needs of the “weak economy” scenario and this would only be possible if the portfolio were successfully implemented in the near term. If medium or high water demands had to be met as envisioned in the other scenarios, additional portfolio actions would be needed in the mid and long term.

Building on the earlier work of the basin roundtables and the IBCC, the CWCB developed a scenario-based adaptive water strategy. While the No-and-Low-Regrets Portfolio is necessary no matter what future Colorado may face, the adaptive framework recognizes that the future hinges upon how the primary drivers—Municipal & Industrial Water Demand, Water Supply Availability, and Social Values—change over time. These drivers could tip the still evolving future toward one scenario or another. These tipping points serve as water management decision points or “signposts” that can lead toward the need to implement a certain portfolio of solutions. By developing an adaptive water-management framework, managers and decision makers will be more aware of approaching signposts and can anticipate the need to make timely water management decisions.

The primary drivers can be explained as follows:

- Future changes in *M&I water demands* may trend “lower” or “higher” relative to the mid-level water demand forecasts used in previous SWSI efforts. Such a change may be anticipated by tracking indicators of economic activity and demographic growth as well as other secondary factors.
- *Water supply availability* may similarly trend “lower” or “higher” depending on climate change, watershed hydrology, and legal constraints associated with Colorado’s interstate compacts, water law, and environmental regulations. Water supply availability will also be assessed as trending lower or higher over time as compared to earlier versions of the Statewide Water Supply Initiative.
- The third primary driver, *social values*, is a measure of statewide public sentiment; it may trend toward a more “green” orientation or it may shift toward greater “resource utilization.” “Green” values will likely favor more dense, low-impact urban development, greater reliance on water reuse and energy efficiency, greater protection of environmental and recreational resources, and preservation of local agriculture and open space. Values associated with more intensive “resource utilization” will gravitate toward full use of existing natural sources as well as the development of new ones to satisfy M&I water demands.

Figure 6.1-6: Colorado's Scenarios and Their Matching Portfolios


















This scenario-based framework allows for incremental implementation of future portfolio response actions beyond the no-and-low-regrets actions recommended in the near term (Figure 6.1-6). Pre-positioned portfolio actions—such as increased levels of conservation, agricultural transfers, or TMDs—can be implemented at specified key signposts. This will allow decision makers to respond adaptively to changes in critical drivers in real time that cannot be predicted with certainty as the future continues to unfold. Water demands, water supply, and social values are used as critical drivers.¹³

Table 6.1-1 shows the relationships between the three primary drivers, scenarios, and portfolios of solutions. The five portfolios selected to match the scenarios best meet both the future conditions described in the scenario balanced with Colorado's Water Values.

The no-and-low-regrets actions will not be easy to accomplish. Nevertheless, if these are not implemented in the next fifteen years, the effects will be severe. The water supply gap will be greater than any basin roundtable envisioned, and the solutions will dry up more agriculture and cause further harm to the environment. If Colorado faces high demands and the no-and-low-regrets actions are not fully implemented, the State would have to implement projects and methods beyond anything the basin roundtables have planned for as part of the portfolio development process. Depending on the scenario, this could be an even larger TMD, draconian conservation measures, or even greater amounts of agricultural dry up. These approaches would not be consistent with Colorado's Water Values; therefore, it is imperative that the no-and-low-regrets actions are implemented.

Table 6.1-1: Scenarios and their Matching Portfolios

		Scenarios				
		B Weak Economy	C Cooperative Growth	A Business as Usual	D Adaptive Innovation	E Hot Growth
Scenario Drivers	Water Demand	Lower	Lower	Higher	Higher	Higher
	Water Supply	Higher	Lower	Higher	Lower	Lower
	Social Values	No Change	"Green"	No Change	"Green"	"Resource Utilization"
Portfolios of Solutions (Height indicates how much additional water is needed, and color represents the source of water supplies.)		 Low Demand Conservation Portfolio / No-and-Low Regrets Portfolio	 Mid Demand Conservation Portfolio	 Mid Demand Mixed Portfolio	 High Demand Conservation Portfolio	 High Demand Mixed Portfolio
 IPPs, western slope (WS)  Active conservation, WS  Ag. transfers, WS  Co. River development, WS  ES reuse of ag. transfers		 IPPs, eastern slope (ES)  Active conservation, ES  Ag. Transfers, ES  Co. River development, ES (new TMD)  ES reuse of new TMD				

Section 6.2 assesses whether or not the BIPs would meet at least the no-and-low-regrets actions. Sections 6.3 through 6.6 and Chapter 8 explore in detail how, at minimum, the no-and-low-regrets actions can be implemented through the BIPs and other stakeholder projects and methods for obtaining financial support, education efforts, partnerships, and legislative solutions.

If successfully implemented, this adaptive water strategy provides a roadmap to a still evolving future. Given the many vagaries inherent in predicting future conditions, the plan must be a living document. As new critical drivers arise or as decision points change over time, the scenarios and associated response-action portfolios will need to be reassessed and revised in subsequent updates to the Statewide Water Supply Initiative.

Actions

The following actions are needed to continue to support developing scenario planning and Colorado's adaptive strategies:

1. **Support the implementation of the no-and-low-regrets:** The CWCB, in partnership with other state agencies, will commit state financial, technical, and regulatory resources to the near-term implementation of prioritized water management projects, as specified in the no-

and-low-regrets actions. As part of this work and in partnership with the basin roundtables, the CWCB will evaluate progress toward achieving the no-and-low-regrets actions.

2. **Monitor drivers:** To determine which scenario Colorado will most likely face, the CWCB will work with partners, such as the Climate Change Technical Advisory Group, to monitor the critical drivers of water supply, demand, and the level of “green” versus “full resource use” values through future Statewide Water Supply Initiative updates and other technical work. As part of this work the CWCB will work with stakeholder groups to update the scenarios and adaptive strategies.
3. **Promote use of scenario planning & adaptive strategies:** The CWCB and the basin roundtables will continue to use and promote scenario planning and the use of adaptive strategies to respond to, mitigate for, and prepare for climate change. The CWCB will also encourage and facilitate the adoption of adaptive strategies for municipal, industrial, agricultural, environmental, and recreational needs as Colorado moves into the future in partnership with project proponents.
4. The CWCB and the Division of Water Resources (DWR) will continue to develop and support Colorado’s Decision Support Systems (CDSS) to encourage data-driven planning and decision making.

6.2 Meeting Colorado’s Water Gaps

Colorado’s Water Plan uses a grassroots approach to formulate projects and methods that avoid some of the undesirable outcomes of the supply-demand gaps. The plan addresses the gap from multiple perspectives (e.g., water storage, reuse, recycling, integrated water management, restoration and conservation)..

Overview

This section describes how the basin roundtables’ BIPs meet Colorado’s growing municipal, industrial, agricultural, environmental, and recreational water needs. This section describes the BIP goals and measurable outcomes and identifies by basin the remaining needs that must be met to accomplish those objectives. These remaining needs are referred to as “gaps.” The section relies on previous technical work conducted in the SWSI 2010, the Basin Needs Assessments, and the no-and-low-regrets work described in Section 6.1. Finally, this section ends with a list of actions to support closing Colorado’s water gaps. In comparison, Sections 6.3 through 6.6 indicate the types of projects and methods the BIPs consider and the actions needed to support them.

Colorado’s Water Plan does not prescribe or endorse specific projects. However, implementing a combination of projects and methods, as outlined in the BIPs, will be necessary to meet Colorado’s current and future municipal, industrial, agricultural, environmental, and recreational water needs. Failing to implement the projects and methods outlined in the BIPs will result in an even greater water gap in Colorado’s future.

In compiling its BIP, each basin roundtable developed goals and measurable outcomes that add up to a vision for how each basin plans to support each major sector. While a water supply gap for M&I needs is relatively easy to quantify, the future needs of agriculture, the environment, recreation, and other uses identified in the BIPs, are based on the vision of each basin roundtable.

Goals and Measurable Outcomes by Basin

The degree to which the BIP goals and measurable outcomes demonstrate concurrence across Colorado is remarkable. The CWCB developed several long-term themes to meet the objectives outlined in the Governor's Executive Order.¹⁴ These include:

1. Meet municipal water needs throughout Colorado
2. Meet Colorado's agricultural water needs
3. Meet Colorado's environmental and recreational water needs

In addition, Colorado has a long-term goal related to water quality, which is discussed in Section 7.3:

4. Meet Colorado's water quality management needs

Each of these major themes is reflected in the BIP goals and measurable outcomes. Additionally, the basin roundtables identified several additional major themes that reached across all BIPs. These include:

- Protect and restore watershed health
- Multi-purpose storage/balance all needs and reduce conflict
- Comply with and manage the risk associated with interstate compacts and agreements
- Continue participation, education, outreach, and communication

Table 6.2-1 demonstrates the common themes found across the eight BIPs, and outlines the steps by which the BIPs propose to specifically address these themes.

Below is a brief summary of how the BIPs addressed these themes.

Meet Colorado's Municipal Water Needs through Conservation and Identified Projects and Methods: Every BIP discusses the importance of conservation. This is especially a focus for the Arkansas, Colorado, South Platte, and Southwest Basin Roundtables. The Southwest and South Platte BIPs focus on implementing already specified Identified Projects and Processes (IPPs) from SWSI 2010. The Southwest and the Colorado BIPs also identify additional projects and methods. Reuse is also featured in the Colorado, South Platte, and Arkansas BIPs.

Meet Colorado's Agricultural Needs: In general, the Arkansas, Colorado, Rio Grande, and Southwest Basin Roundtables are approaching agricultural needs from an economic and productivity standpoint. The North Platte and Yampa/White Basin Roundtables seek to increase their irrigated acres, while several basins, such as the Gunnison and Colorado, seek to reduce agricultural shortages. Nearly every basin is also focused on improving agricultural efficiencies and modernizing water infrastructure. The South Platte and Metro Basin Roundtables are concerned about maintaining the viability of agriculture in the South Platte against the pressure of agricultural transfers and urbanization, and are therefore exploring alternative options including the successful implementation of conservation, reuse, IPPs, alternative agricultural transfers, and the development of new supplies from the Colorado River system. Some western slope BIPs, such as the Southwest BIP, indicate that agriculture across the state is important and have expressed support for strategies such as high conservation to minimize the potential impact. The South Platte BIP indicates that all of these will be needed to reduce the pressure on agricultural transfers. The Rio

Grande BIP expresses concern about maintaining the viability of agriculture in the face of current unsustainable groundwater depletions.

Table 6.2-1: Common Themes Across BIPs

✓ = BIP goal or measurable outcome; ✓ = BIP activity

	Ark	Co	Gu	NP	RG	SP/Mt	SW	Y/W/G
A. Meet Municipal Water Needs throughout Colorado								
• Focus on M&I Gaps	✓	✓	✓	✓	✓	✓	✓	✓
• Focus on Conservation / Demand Management	✓	✓	✓	✓	✓	✓	✓	✓
B. Meet Colorado's Agriculture Needs								
• Focus on agricultural economy	✓	✓			✓	✓		
• Focus on reducing shortages		✓	✓			✓	✓	✓
• Improve agricultural efficiencies	✓	✓	✓		✓		✓	✓
• Increase irrigated acres				✓				✓
• Conduct the goals while protecting private property rights	✓	✓	✓	✓	✓	✓	✓	✓
C. Meet Colorado's Environmental and Recreational Water Needs								
• Focus on recovering imperiled and/or endangered species	✓	✓	✓	✓	✓	✓	✓	✓
• Protect wetlands and riparian areas	✓	✓	✓	✓	✓	✓	✓	✓
• Protect recreation	✓	✓	✓	✓	✓	✓	✓	✓
• Quantify nonconsumptive needs	✓	✓	✓			✓	✓	✓
H. Meet Colorado's Water Quality Management Needs								
• Includes one or more goals / activities on water quality	✓	✓	✓	✓	✓	✓	✓	✓
D. Protect and Restore Watershed Health								
• Includes one or more goals / activities associated with watershed health	✓	✓	✓	✓	✓	✓	✓	✓
E. Balance All Needs and Reduce Conflict / Multi Purpose Storage								
• Protect Private Property Rights / Water Rights	✓	✓	✓	✓	✓	✓	✓	✓
• Multi-purpose Focus	✓	✓	✓	✓	✓	✓	✓	✓
• Modernize water infrastructure	✓		✓	✓	✓	✓	✓	✓
• Determine how agriculture supports nonconsumptive needs	✓	✓	✓	✓	✓	✓		✓
• Increase storage	✓	✓	✓	✓	✓	✓	✓	✓
F. Comply with Interstate Compacts, agreements, and manage the risk associated with these								
• Includes one or more goals / activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓
G. Continue Participation, Education, Outreach, and Communications								
• Includes one or more goals / activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓

Meet Colorado's Environmental and Recreational Needs: Environmental, water quality and quantity needs and objectives are critical for each of our basins. Every BIP discusses the need to recover imperiled and/or threatened and endangered species and protect recreational facilities, wetlands, and riparian areas. In addition, several BIPs state the need to further quantify environmental and recreational needs and the Gunnison, South Platte, and Yampa/White/Green BIPs discuss the need to better determine how agriculture supports environmental and recreational values.

Meet Colorado's Water Quality Management Needs: Although water quality is not an issue traditionally studied by the basin roundtables, every BIP addresses water quality. Section 7.3 summarizes the BIP water quality efforts.

Protect and Restore Watershed Health: While the Arkansas, North Platte, Rio Grande, and Southwest Basin Roundtables are the most focused on watershed health, every BIP recognizes the importance of watershed health. Many BIPs link watershed health to environmental needs or protecting important infrastructure for municipal and agricultural needs. Section 7.1 summarizes the BIP watershed health efforts.

Continue Participation, Education, Outreach, and Communications: Every basin roundtable has active education and outreach activities, as described in Section 9.5.

While each of the above topics demonstrate a gap associated with the goals and measurable outcomes, there are also several other important themes demonstrated throughout the BIPs that do not involve gaps. Some of these include:

- **Protect Private Property and Water Rights:** Every BIP makes it clear that solutions to protect agriculture and the environment need to be done in the context of protecting private property and water rights. This general theme is consistent with Colorado's Water Plan.
- **Comply with and Manage the Risk Associated with Interstate Compacts and Agreements:** Every basin in Colorado must grapple with interstate compacts or agreements and each basin has addressed this topic explicitly in its BIP. Chapter 8 discusses how the BIPs address the issue of TMDs.
- **Multi Purpose Storage and Projects / Balance All Needs and Reduce Conflict:** Every BIP stressed interest in multi-purpose projects and approaches. Some, like the Arkansas, Colorado, North Platte, Rio Grande, and South Platte/Metro Basin Roundtables, are interested in how agriculture supports nonconsumptive needs. The Arkansas, South Platte, Rio Grande, and Southwest BIP goals also explicitly discuss the need for multi-purpose projects.

Meeting M&I Water Needs Throughout Colorado

In the BIP process, the CWCB identified three statewide long-term goals to meet community water needs throughout Colorado:¹⁵

- Use water efficiently to reduce overall future water needs
- Identify additional projects and processes to meet the water supply gap for municipalities while balancing the needs of agriculture, the environment, and recreation across the state
- Meet community water needs during periods of drought

The Statewide Water Supply Initiative in 2010 indicated that under current conditions the M&I gap could be between 190,000 and 630,000 acre-feet, depending on how many planned projects are implemented and the rate of population growth in Colorado.

To address at least the minimum water gap, the basin roundtables and the IBCC, developed several no-and-low-regrets goals and measurable outcomes, as described in Section 6.1. For M&I uses,

examples of measurable outcomes that would meet these no-and-low-regrets actions were described for developing IPPs, and in many cases were broken out by basin. These measurable outcomes include actions such as reuse, conservation, agricultural transfers, and Colorado River supplies:¹⁶

- *Establish low/medium conservation strategies*
 - Implement strategies at the basin level to meet medium levels of conservation, and apply half of that to meet the M&I gap, equivalent statewide to 67,000 acre-feet per year by 2030 and 167,000 acre-feet by 2050.
 - 2050 conservation savings by basin:
 - Arkansas: 36,000 acre-feet
 - Colorado: 15,000 acre-feet
 - Gunnison: 4300 acre-feet
 - North Platte: 85 acre-feet
 - Rio Grande: 3200 acre-feet
 - South Platte(including Metro Area): 97,000 acre-feet
 - Southwest: 7500 acre-feet
 - Yampa/White/Green: 3700 acre-feet
- *Have a high success rate for IPPs*
 - Implement IPPs to yield 80 percent statewide, equivalent to 70,000 acre-feet per year for the western slope and 280,000 acre-feet per year for the eastern slope
 - 2050 no/low regret IPP success by basin:
 - Arkansas: 76,000 acre-feet
 - Colorado: 45,000 acre-feet
 - Gunnison: 12,000 acre-feet
 - North Platte: 100 acre-feet
 - Rio Grande: 6000 acre-feet
 - South Platte(including Metro Area): 200,000 acre-feet
 - Southwest: 13,000 acre-feet
 - Yampa/White/Green: 7000 acre-feet
- *Implement Reuse Strategies*
 - 25,000 acre-feet per year of yield resulting from new agricultural transfer and TMD projects above and beyond the IPPs in the South Platte and Arkansas Basins.
- *Plan and Preserve Options for Existing and New Supply*
 - Develop 35,000 acre-feet per year of new supplies in the Colorado River system for the western slope.
 - Develop a conceptual agreement among basin roundtables regarding how to preserve/not preclude a potential future transbasin diversion from the western slope to the eastern slope. (The Draft Conceptual Agreement developed by the IBCC is discussed in Chapter 8)

Many of the BIPs seek to meet these short- and long-term M&I goals; this subsection reviews BIPs by basin. Table 6.2-2 summarizes the success of each basin in meeting the overall water supply gap for municipalities and industry.

Table 6.2-2: Summary of BIPs Addressing the M&I No-and-Low-Regrets and Gaps

Basin	2050 New Needs (acre-feet) ¹⁷	2050 Gap (acre-feet) ¹⁸	BIP ID'd Potential New P&M acre-feet	# of New Projects w/ acre-feet info	Are No/Low Regrets Likely Met?	Notes
Arkansas	110,000 - 170,000	59,500 ¹⁹ (M&I Shortage) 45,000 - 94,000 (SWSI 2010)	125,000	10	Yes: Conservation strategy; will do reuse w/ new development; expresses similar concepts to and discusses conceptual agreement; basin goal to increase surface storage by 70,000 acre-feet	Projects listed in the BIP were prioritized in a IPPs list.
Colorado	65,000 - 110,000	26,000 - 48,000	40,272 (20,272 in projects & 20,000 from high active conservation)	3	Yes: high conservation; some IPP success; identify additional Colorado River Basin supply projects	The BIP identified priority projects by region, and the largest project has a large agricultural component, so it is unclear if the gaps will be fully met with only the priority projects. ²⁰
Gunnison	16,000 - 23,000	3700 - 6100	17,500(12,000 in projects & 5500 from high active conservation)	4	Yes: high conservation; success of IPPs; identify f additional Colorado River Basin supply projects	BIP indicates M&I needs “are generally expected to be managed with sufficient existing supplies and/or through planned projects” ²¹
North Platte	100-300	10 - 30	N/A	Completed Project	Yes: accept conservation standards; IPP success; does not discuss conceptual agreement	The North Platte has met its municipal gap ²²
Rio Grande	7700 - 13,000	2300 - 5100	800	1	Partially: little conservation discussion; some IPP success	Because the basin is focused on groundwater sustainability, the BIP did not identify additional acre-feet for municipal projects ²³ Quantification based on current information provided by basin.
South	340,000 -	428,000 ²⁴	77,495	15 projects	Partially: largely	The BIP

Table 6.2-2: Summary of BIPs Addressing the M&I No-and-Low-Regrets and Gaps

Basin	2050 New Needs (acre-feet) ¹⁷	2050 Gap (acre-feet) ¹⁸	BIP ID'd Potential New P&M acre-feet	# of New Projects w/ acre-feet info	Are No/Low Regrets Likely Met?	Notes
Platte	505,000			+ 3 Portfolios	conceptual, some conservation, IPP success, reuse success, some agricultural transfers, support conceptual agreement in concept	developed portfolios ²⁵
Southwest	20,000 - 31,000	8800 - 16,000	40,354	6	Yes: high IPP success; develop additional Colorado River Basin supplies; support many aspects of conceptual agreement and indicate conceptual agreement is "in progress"	Projects and methods identified will meet M&I gap as well as the infrastructure needs of the basin ²⁶
Yampa / White / Green	34,000 - 95,000	24,000 - 83,000	201,000	8	Yes: some conservation; high IPP success; develop additional Colorado River Basin supplies; discusses some similar concepts to conceptual agreement and will continue to engage	The BIP plans to update aM&I shortage analysis. ²⁷
TOTALS	592,800 – 947,300	552,310 – 645,730	502,421	47 projects and 3 portfolios		

This column represents the total number of acre-feet gathered from the projects and methods (P&M) identified in the BIPs, which could serve municipal or industrial uses. Conservation is included as a method. The values do not consider hydrological limitations. Some BIPs are still "in process" in developing acre-feet associated with newly identified projects and methods.

The current no-and-low regrets and SWSI 2010 gap calculations do not take into account the potential effects of climate change. As discussed throughout this plan, warming temperatures can affect water supply, water availability, and demands. Should average annual temperature continue to increase at projected levels (2.5 to 5° F), by mid-century, it is reasonable to expect that the existing gap would increase.



Arkansas

The Arkansas Basin faces an immediate municipal gap in some areas, especially if the need to replace nontributary groundwater in El Paso and Elbert counties is taken into account.²⁸ Future needs in the Arkansas Basin are likely to increase by 110,000 to 170,000 acre-feet and currently planned projects leave a municipal water supply gap within the basin of between 45,000 to 94,000 acre-feet. This assumes

that identified projects and processes are implemented at a relatively high success rate.²⁹

Arkansas goals and measurable outcomes

To address this municipal gap, the Arkansas BIP identifies four goals related to meeting M&I needs.³⁰ These goals and the associated measurable outcomes are:

- Meet the municipal supply gap in each county within the basin.
 - Generate a study by December 2015 determining surpluses and deficits within sub-regions/counties.
 - Funds provided in support of collaborative efforts reported annually.
- Support regional infrastructure development for cost-effective solutions to local water supply gaps.
 - Agreements to regional use of identified IPPs such as Southern Delivery System.
 - New Water Supply Reserve Grant (WSRA) grant request for regional infrastructure studies.
 - Agreements for off take of conduit water; funding of conduit processes and construction.
- Reduce or eliminate Denver Basin groundwater dependence for municipal users.
 - Presentations by groundwater dependent entities on solutions that have been implemented.
 - Presentations on interim solutions and funding requests to support those solutions and funding requests to support those solutions.
 - Funds provided in support of collaborative efforts reported annually.
- Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.
 - Pilot project implemented as reported annually.
 - Engineering template implemented by the DWR to expedite temporary transfers at reduced cost.
- Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.
 - Storage capacity and percentage of stored water annually from 2015 to 2020.
- Annual reporting of projects that have been permitted and/or constructed

Meeting the Arkansas' M&I gaps

The BIP supports the three primary recommendations to address the M&I supply gap in the Arkansas Basin as outlined in the 2010 SWSI:³¹

- The Arkansas Basin Roundtable acknowledges a limited number of identified projects and processes may be able to meet most of the gap.
- Storage is essential to meeting all of the basin's consumptive, environmental, and recreational needs. In addition to traditional storage, aquifer storage and recovery must be considered and investigated as a future storage option.
- The roundtable identified a critical gap as the need to replace nonrenewable groundwater and augment the sustainability of designated basins.

The basin has identified six projects that address M&I needs, four that address both M&I and agricultural needs, and one conservation project within their 2015 IPPs list, which include a

measure of acre-feet. The M&I projects identify 77,500 new acre-feet, the combined M&I and agriculture projects identify 48,000 new acre-feet, and the conservation project may reduce 500 acre-feet by 2030. Basin M&I gaps are met through these projects. Additionally, the BIP identifies examples of rehabilitation of nonfederal reservoirs in the Arkansas basin to modern standards. If all potential rehabilitations were implemented, 220,775 acre-feet would be affected and the estimated costs of the repairs would be \$37,500,000.³²

Actions to meet the basin goal of increasing surface storage available within the basin by 70,000 acre-feet by 2020 include:

- Implement a critical IPP .
- Work with the State Engineer's Dam Safety Program to identify storage projects for restoration, rehabilitation, and increased capacity.
- Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.

These actions will work to meet both M&I and agricultural gaps.



Colorado

The Colorado Basin faces a gap that could begin as early as 2030 in Mesa County.³³ Future needs in the basin are likely to increase from between 65,000 to 110,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Colorado Basin of 26,000 to 48,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.³⁴

Colorado goals and measurable outcomes

To address this municipal gap, the Colorado BIP identifies seven goals related to meeting M&I needs.³⁵ These goals and the associated measurable outcomes are:

- Develop land use policies requiring and promoting conservation.
 - Develop recommendations for city, county, and state governing bodies promoting water awareness and efficiency in land use policy.
 - Develop educational materials or opportunities for municipal and county elected officials and planning officials on water supply issues and conservation options.
 - Preserve agriculture and reduce the transfer of agriculture water to municipal use.
- Raise awareness of current obstacles and efforts facing water providers.
 - Publish a summary of state and basin water providers' true cost of water by analyzing operation and maintenance costs including sustainable infrastructure replacement programs.
 - Development of national, state or local funding assistance programs to replace aging infrastructure.
 - All basin water providers have sustainable infrastructure replacement funding programs.
- Protect drinking water supplies from natural impacts such as extended droughts, forest fires, and climate change, among others.

- Every basin water provider has a reliable redundant water supply to meet 2050 demands.
 - Colorado Basin Roundtable or the CWCB to establish a biannual basin conference on natural disaster planning for water providers and government officials.
- Improve water court process
 - Recommendations to improve the objector process.
 - Recommendations to limit vulnerability of water rights when changing existing water rights in water court.
 - Improvements to Colorado water law to encourage agricultural water efficiency practices without harming water right value.
- Secure growing water demand by developing in-basin supplies and expanding raw water storage supply.
 - All basin water providers to meet current supply needs with redundancy, drought plans, and viable project options to meet future water needs.
 - Reduce average permitting time for a reservoir project to less than 10 years.
 - Establish regional water provider and ditch company cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects, and addressing environmental and recreational needs.
 - Reduce demands by establishing water conservation goals and strategies.
- Improve Colorado Water Law to encourage efficiency, conservation, and reuse.
 - Revised Colorado water law through legislation to allow more flexibility among water providers and the agricultural community to promote stream health through conservation, bypass flows, and flexibility in diversion location.
 - Reduce time of average Division 5 water court process by adding staff including judges, referees, and supporting staff.
- Pursue continued M&I conservation.
 - Achieve and sustain a high level of conservation by all basin water providers and industrial users.

Meeting the Colorado's M&I gaps

The Colorado Basin went through a prioritization process to identify high ranking projects to include in their BIP. From this initial list of high priority projects, 20,272 acre-feet of additional supplies beyond the IPPs, were quantified to meet both M&I and agricultural gaps. This value does not exceed the amount needed under no-and-low regrets or the high potential M&I gap of 48,000 acre-feet identified in SWSI 2010.³⁶ However, the basin's full project list from the BIP developed an extensive list of potential M&I projects by interviewing more than 60 water providers throughout the basin.³⁷ If all of the projects and methods identified were implemented, as a whole the Colorado Basin's M&I gap would be more than met. The BIP identified 54 potential M&I projects that quantified the acre-feet. These added up to nearly 510,000 to 540,000 acre-feet, which far exceeds the amount needed under no-and-low regrets and also the high potential M&I gap of 48,000 acre-feet identified in SWSI 2010.³⁸ In addition, each geographic region identified in the BIP could meet its future needs if the listed projects were implemented.³⁹ However, uncertainty exists about

whether each municipality would be able to access these water supplies projects' viability and given that many have not identified a project proponent. The projects from the first draft's list will most likely need to be implemented in addition to those identified as high priority to meet basin M&I goals.

In addition to these projects, the Colorado BIP also advocates for high conservation standards, as identified in SWSI 2010. This would likely result in another 24,000 acre-feet of saved water from active conservation that could be applied to meet future demands. The BIP supports the implementation of conservation best practices and education about land use decisions to support accomplishing high conservation.

In conclusion, if the Colorado River basin were able to implement high conservation and a tenth of the yield identified in the new projects identified from the draft and high priority project lists, then the M&I gap should be fully met. However, there is uncertainty regarding the viability of many of the projects to be implemented and specific commitments from water providers to rely on these projects or commit to high conservation levels.



Gunnison

The Gunnison Basin faces a gap that could begin as early as 2035 in Delta County.⁴⁰ Future needs in the basin are likely to increase by 16,000 to 23,000 acre-feet and currently planned projects leave a municipal water supply gap within the Gunnison Basin of 3,700 to 6,100 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁴¹ In addition, the

Gunnison BIP states that demands in Ouray County may be higher than indicated in SWSI 2010.⁴²

Gunnison goals and measurable outcomes

To address this municipal gap, the Gunnison BIP identifies one goal related to meeting M&I needs.⁴³ That goal and the associated measurable outcomes are:

- Identify and address M&I water shortages.
 - Reliably meet 100 percent of essential municipal water provider system demands in the basin through the year 2050 and beyond.
 - Continue the current baseline of effective water conservation programs by covered entities in the basin, with the goal being high levels of conservation savings as defined in SWSI 2010.

In addition, the Gunnison BIP outlines the following statewide principles related to municipal conservation, including implementation steps:⁴⁴

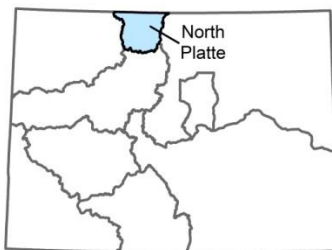
- Water conservation, demand management, and land use planning that incorporates water supply factors should be equitably employed statewide.
 - Work with other basin roundtables to support conservation, demand management, and the incorporation of water supply factors into land use planning and development.

- Promote programs that encourage drought tolerant vegetation and discourage lawn irrigation.

Meeting the Gunnison's M&I gaps

The Gunnison Basin Roundtable identified two water conservation activities and four projects ranked as tier 1 (implementation likely feasible by 2025; project does excellent job of meeting Basin Goals) that were not identified in SWSI 2010 that would help meet future M&I needs. The four projects would provide approximately 11,547 to 11,647 acre-feet if implemented.⁴⁵ This volume fully meets the gap identified in SWSI 2010. The Gunnison BIP states that "M&I needs ... are generally expected to be managed with sufficient existing supplies and/or through planned projects."⁴⁶ Given this analysis, the Gunnison Basin's M&I gap is considered met.

In addition to these projects, the Gunnison BIP also advocates for high conservation standards, as identified in SWSI 2010. This would likely result in another 5500 acre-feet of saved water from active conservation that could be applied to meet future demands.



North Platte

The North Platte Basin no longer has an M&I supply gap. As stated in the North Platte BIP, "The North Platte Basin has only one municipal water provider, the Town of Walden, serving a population of about 600. Limitations to the town's water supply were identified in the original SWSI report, and subsequently addressed through a

CWCB-funded study and multi-alternative project, eliminating the only municipal water supply gap in the basin."⁴⁷

North Platte goals and measurable outcomes

Nonetheless, the BIP indicated support for municipal conservation, which could help meet any additional needs. This goal and associated measurable outcome are:

- Support the equitable statewide application of municipal water conservation.
 - Comply with future statewide municipal conservation strategies and any related legislation by 2020 or as appropriate.

Meeting the North Platte's M&I gaps

As stated previously, the North Platte's future M&I needs have been met.



Rio Grande

The Rio Grande Basin has a relatively small, though important M&I gap. According to the CWCB's analyses, this gap could begin as early as 2025 in Costilla County.⁴⁸ These studies indicate that future needs in the Rio Grande are likely to increase by 7700 to 13,000 acre-feet and currently planned projects leave a municipal water supply gap

within the Rio Grande Basin of between 2300 to 5100 acre-feet.⁴⁹ This assumes that identified projects and processes are implemented at a relatively high success rate.⁵⁰ The Rio Grande Basin would like to better determine the amount, timing, and location of the gap once the Rio Grande Decision Support System groundwater model is ready. It is expected that most water providers will have a gap and will need to join a groundwater management subdistrict or develop an independent augmentation plan.

Rio Grande goals and measurable outcomes

To address this municipal gap, the Rio Grande BIP identifies three primary goals related to meeting M&I needs. These goals and the associated measurable outcomes are:⁵¹

- Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.
 - A database of existing water infrastructure including documentation of infrastructure condition and mapping of all storage reservoirs and major ditch diversions is created.
 - Reservoirs operate at full design capacity without restrictions.
 - Diversion structures and conveyance systems function optimally.
 - Municipal potable water supplies are adequate to meet needs.
 - Water supplies and wastewater treatment systems are fully functional and meet all necessary standards.
- Support the development of projects and methods that have multiple benefits for agricultural, M&I, and environmental and recreational water needs.
 - Opportunities for multiple use benefits have been explored and implemented where possible.
 - Multiple-purpose projects will have preference in the funding process.
- Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
 - Reduce per capita per day water use to a reasonable level.
 - Inventory existing and expected future M&I and environmental and recreational water needs.
 - Add hydropower electrical generating capacity where possible.
 - Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing effects on other uses.

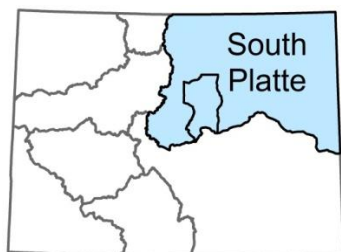
Meeting the Rio Grande's M&I gaps

The Rio Grande BIP identified very few municipal projects beyond the identified projects and processes in SWSI 2010, and only one of these provides additional acre-feet to meet growing municipal needs. The BIP acknowledges this by stating:

While M&I and self-supplied industrial (SSI) water use will remain a small percentage of overall basin water use, it is important to provide additional resources to M&I water providers to assist them in meeting future needs by identifying and assisting in the development of:

- Measures to manage water demands and return flows and develop methods to receive augmentation credits for wastewater discharges and lawn irrigation return flows.
- Water rights, storage and augmentation supplies, either directly or through the groundwater management subdistricts.
- Finalization of the Rio Grande Decision Support System groundwater model so that M&I pumping depletions can be determined in amount, timing, and location.⁵²

Because of this, the Rio Grande has not yet quantified its future M&I gap. Once well pumping depletions have been determined in amount, timing, and location, the M&I providers will either join a subdistrict or develop an independent augmentation plan.



South Platte (including the Metro Area and Republican Basin)

The Metro, South Platte, and Republican Basins face a municipal gap that could begin as early as 2020 in the Lower South Platte. When taking into account the need to replace nontributary groundwater, in the South Metro area, that gap already exists.⁵³ The potential gap in the Lower South Platte is relatively small compared to the urbanized Front Range, which holds the largest gap in Colorado. Future needs in

the basin as a whole are likely to increase by 340,000 to 505,000 acre-feet. However, the additional water needs from hydrologic fracturing must be added to the water supply gap. With existing data, currently planned projects leave a municipal water supply gap within Colorado's northeast region of 203,000 to 312,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁵⁴

South Platte goals and measurable outcomes

To address this M&I gap, the South Platte BIP developed a long-term goal to meet M&I needs:⁵⁵

Meet community water needs throughout Colorado by: 1) Using water efficiently with high levels of participation in conservation programs; 2) Developing additional water throughout the state through balanced, multi-purpose projects and methods; and 3) Assuring strong drought protection programs through broad development of protection plans and dedicated reserves potentially including storage, interruptible service agreements (ISAs), water banks, water use restrictions and non-tributary groundwater, among others.

In the short-term, the South Platte developed four goals and associated measurable outcomes to meet the large M&I water supply gap in the South Platte Basin:⁵⁶

- Continue the South Platte River Basin's leadership in wise water use.
 - Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.

- Distribute and encourage adoption of “best management practices” as “guidelines” (not standards) for M&I water suppliers to consider in their “provider-controlled” programs recognizing the substantial differences in climates, cultures, and economic conditions throughout the South Platte River Basin.
 - Enhance current levels of municipal water reuse and consider studies to quantify the effects of: 1) additional municipal water conservation on water available for reuse; 2) additional municipal water reuse in relation to water available for exchanges; 3) reuse and successive uses of water downstream including effects on agricultural water shortages.
 - Ensure conservation, reuse, and drought management plans take into consideration environmental and recreational focus areas and attributes.
- Bring a high percentage of entries in the updated IPP list online as a key strategy consistent with the “no/low regrets” scenario planning approach.
 - Maximize implementation of the updated IPP list.
 - Encourage multi-purpose projects that also provide environmental and recreational considerations. Foster opportunities to improve environment and recreation conditions of affected watersheds in association with IPPs.
- To the extent possible, develop multi-purpose storage, conveyance, system interconnections, and other infrastructure projects to take advantage of limited remaining South Platte supplies and enhance water use efficiencies and supply reliability.
 - Explore opportunities to maximize yield from additional South Platte Basin strategic and multi-purpose storage and other infrastructure including collaborative interconnections between water supply systems and above ground and groundwater (e.g. Aquifer storage and recharge (ASR) and alluvial recharge) storage.
 - Encourage multi-purpose projects that provide environmental and recreational considerations.
 - Take into consideration environmental and recreational attributes when considering Storage and Other Infrastructure projects and methods.
- Maintain, enhance and proactively manage water quality for all use classifications.
 - Maintain or improve the delivery of safe water supplies throughout the basin.
 - Monitor, protect and improve watershed water quality and identify and document progress and improvements.
 - Improve areas where water quality may be limiting the suitability of focus areas identified by BRTs through environmental and recreational mapping efforts.
- Develop agreements governing additional transbasin water imports that: 1) are in accordance with the South Platte Basin’s overarching theme that economic, environmental and recreational benefits should equitably accrue to both the western slope and the eastern slope; 2) include project(s) or project elements that provide multiple types of uses; 3) supported with state investment; and 4) provide enough certainty in conditions to substantially lessen current trends of traditional buy-and-dry transfers from agricultural uses to M&I uses.
 - Through the IBCC, negotiate a conceptual agreement with the western slope basin roundtables on investigating, preserving, and developing potential options so that

future multi-purpose projects benefiting both slopes can be addressed on a timely basis.

- Encourage multi-purpose projects that provide environmental and recreational considerations.

Meeting the South Platte's M&I gaps

The South Platte BIP developed a list of potential M&I projects, a conservation strategy, and some initial portfolio development to accomplish these goals and meet the identified M&I gaps.⁵⁷ The South Platte BIP used similar categories to the no-and-low-regrets work described in Section 6.1 and a comparison is provided below:

- The BIP partially meets the no-and-low regrets goals associated with conservation. The Metro and South Platte Basins are estimated to further reduce per capita M&I demand to 129 gallons per day per capita (GPCD) and 146 GPCD, respectively. The BIP applies 50 percent of active conservation savings plus all passive savings to meet future needs in their portfolio work. Out of a total of 211,000 acre-feet of quantified potential savings, 105,000 acre-feet is passive, and another 53,000 acre-feet of active conservation savings is applied to future needs. A substantially higher percentage of active conservation would need to be applied to fully meet the no-and-low-regrets goal of applying 197,000 acre-feet to meet new demands.
- The BIP meets the no-and-low-regrets goal of 199,000 acre-foot yield. The no-and-low-regrets action assumed a success rate to the IPPs of about 70 percent, which includes planned reuse, agricultural transfers, in-basin projects, and planned cooperative TMDs. The South Platte BIP assumes a 65 percent success rate and Metro assumes an 80 percent success rate. In addition, the BIP identified a total of 16 new projects (seven for reuse, four agricultural transfers, and five in basin projects) that were not previously in SWSI 2010. The total yield from the basin IPPs more than meets the no-and-low-regrets goals, yielding about 225,000 acre-feet.
- The no-and-low-regrets indicated that 22,000 acre-feet of reuse water would need to be generated from new agricultural diversions and any new TMD projects. The BIP proposes 45,010 new acre-feet of water from re-use. Although discussed in the South Platte BIP, no reuse from these new projects was calculated in the BIP's portfolio work.
- The no-and-low-regrets action plan identified 44,000 acre-feet of additional agricultural transfers was needed at a minimum, and states that these transfers should ideally be alternative agricultural transfers. The BIP identified 4560 acre-feet of alternative transfer methods (ATMs). It also identified that with conservation applied to meet new demands, between 25,000 and 90,000 acre-feet of additional agricultural dry-up would be needed for portfolios B and C. Therefore, the BIP likely meets this no-and-low-regrets goal. In portfolios B and C, about 35,000 acre-feet of alternative transfer method water was identified. The BIP also includes recommendations to streamline transaction costs for ATMs.



Southwest

The Southwest Basin faces a gap that could begin as early as 2015 in Montrose County.⁵⁸ Future needs in the Southwest Region are likely to increase by 20,000 to 31,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Southwest region of 8800 to 16,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁵⁹

Southwest goals and measurable outcomes

To address this municipal gap, the Southwest BIP identified four goals related to meeting M&I needs. These goals and the associated measurable outcomes are below:⁶⁰

- Pursue a high success rate for identified specific and unique projects and processes to meet the municipal gap and to address all water needs and values.
 - Complete 40 IPPs aimed at meeting municipal water needs.
- Provide safe drinking water to Southwest Colorado's citizens and visitors.
 - Consistently meet 100 percent of residential, commercial, and industrial water system demands identified in SWSI 2010 in each sub-basin, while also encouraging education and conservation to reduce demand.
 - Implement at least one IPP that protects or enhances the ability of public water supply systems to access and deliver safe drinking water that meets all health-based standards.
- Promote wise and efficient water use through implementation of municipal conservation strategies to reduce overall future water needs.
 - Change the ratio of in-house to outside treated water use for municipal and domestic water systems (referred to as water providers herein) from the current ratio of 50 percent in-house use and 50 percent outside use, to 60 percent in-house use and 40 percent outside use (60/40 ratio) for Southwest Colorado and the entire defined as requiring a water court change case state by 2030.
 - Implement three informational events about water reuse efforts, tools, and strategies.
 - The water providers in the state that are using dry up of agricultural land^a and/or pursuing a new TMD^b shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.
- Support and implement water reuse strategies.

Meeting the Southwest's M&I gaps

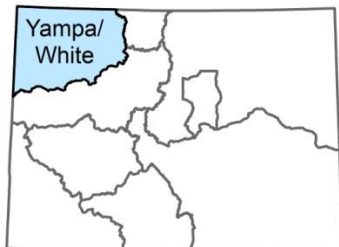
The Southwest BIP developed a list of potential M&I projects by interviewing providers in each sub-basin.⁶¹ The Southwest BIP identified seven new projects that include components that would meet future municipal supply needs, and several others that would address other infrastructure needs

^a Defined as requiring a water court change case.

^b As defined by the IBCC to be a new western slope to eastern slope diversion project.

within the basin. Of these projects, eight quantified acre-feet, totaling nearly 40,000 acre-feet. However, from the information provided it is not clear if each geographic region identified in the BIP will be able to meet its future needs if the listed projects are implemented.⁶²

The Southwest Basin Roundtable acknowledged that while not every identified project was quantified in the BIP, the projects and methods identified would fully meet their M&I water supply gap as well as the infrastructure needs of the basin.



Yampa/White/Green

The Yampa/White/Green Basin faces a gap that could begin as early as 2015 in Rio Blanco and Moffat Counties.⁶³ Future needs in this northwest Colorado region are likely to increase by 34,000 to 95,000 acre-feet according to SWSI 2010. However, these needs will likely be revised downward since all indications are that oil shale will not become commercially viable by 2050.⁶⁴ Energy development from

hydrologic fracturing is a new need that also should be taken into account when calculating the M&I water supply gap. With existing data, currently planned projects leave a municipal water supply gap within Colorado's northwest region of 24,000 to 83,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁶⁵

Yampa/White/Green goals and measurable outcomes

To address this M&I gap, the Yampa/White/Green BIP identified four goals related to meeting M&I needs. These goals and relevant measurable outcomes and processes are below:⁶⁶

- Protect and encourage agricultural uses of water in the Yampa/White/Green Basin within the context of private property rights.
 - Process
 - Identify agricultural water shortages and evaluate potential cooperative and/or incentive programs to reduce agricultural water shortages.
 - Identify projects that propose to use at-risk water rights, alternative transfer methods, water banking, and efficiency improvements that protect and encourage continued agricultural water use.
 - Encourage and support M&I projects that have components that preserve agricultural water uses.
 - Outcomes
 - Preserve the current baseline of about 119,000 irrigated acres and expand by 12 percent by 2030.
 - Encourage land use policies and community goals that enhance agriculture and agricultural water rights.
- Identify and address M&I water shortages.
 - Processes
 - Identify specific locations in the Yampa/White/Green Basin where M&I shortages may exist in drought scenarios and quantify the shortages in time, frequency, and duration.

- Identify effects throughout the Yampa/White/Green Basin in the context of water shortages (drought and climate change), wildfire and compact shortage on M&I demands.
 - Identify projects and processes that can be used to meet M&I needs.
 - Encourage collaborative multi-purpose storage projects.
 - Support efforts of water providers to secure redundant supplies in the face of potential watershed effects from wildfire.
 - Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency
- Outcomes
 - Reliably meet 100 percent of M&I demands in the basin through the year 2050 and beyond through the following processes:
- Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.
 - Processes
 - Encourage and support water quality protection and monitoring programs in the sub-basins of the Yampa/White/Green Basin through watershed groups, municipalities, land management agencies and other efforts.
 - Outcomes
 - Consider and maintain the existing water quality necessary for current and future water uses when reviewing IPPs.
Support the implementation of water quality monitoring programs to create quality-controlled baseline data for all sub-basins of the Yampa/White/Green Basin.

Meeting the Yampa/White/Green's M&I gaps

The Yampa/White/Green BIP conducted the most thorough analysis of how well implementation of future projects and methods would meet M&I needs. In addition, the BIP assessed these needs under a hot and dry future. Below is an excerpt from the BIP describing future shortage potentials:

Municipal Shortages:

M&I demands are small compared to agricultural demands in the Yampa/White/Green Basin. Under Baseline Conditions, no shortages exist to M&I demand nodes because of generally adequate water supply and augmentation from reservoirs.

While M&I shortages exist under the high demand, low water supply scenarios of the Dry Future IPP Scenario and the Dry Future Scenario, the shortages remain below 10 percent. Under both scenarios, District 43 existing M&I in Rio Blanco County (Rangely Water, Meeker Demand) and District 58 existing M&I in Routt County (the City of Steamboat Springs) begin to exhibit shortages, whereas Moffat County municipal nodes do not show M&I shortages under either scenario. If IPPs are developed that include M&I use, shortages would likely decrease in locations with supply augmentation.

Industrial Shortages:

Under Baseline Conditions, no shortages exist for SSI, which consist of thermoelectric power generation needs. Slight shortages exist for the Hayden Station and units 1 and 2 of Craig Station under the Dry Future IPP Scenario and the Dry Future Scenario. These scenarios meet thermoelectric demands with redundant water supplies from Steamboat Lake for Hayden Station and Elkhead and Stagecoach Reservoirs for Craig Station. Using historical data, hypothetical shortages would have occurred for the Hayden Station in the dry months of August 1961, March 1962, September 1977, and September 2002) and for the Craig Station in the dry months of November 1963, September 1977, December 2002, and a few months in 1949.

However, SSI water users consider their water supply short when they must rely upon redundant water supplies. For example, the years 2002, 2003, 2012, and 2013 were considered water supply short or borderline short by some SSI water users because of reliance on redundant supplies. Further discussions will take place on the most appropriate Baseline Conditions and the assessment of shortages in light of drought, climate change, and evolving power generation technologies.⁶⁷

Overall, the BIP modeled nine M&I projects and methods, including conservation in Steamboat Springs, which were not previously identified in SWSI 2010. Only projects that identified a project proponent, a location, physical characteristics, and operations were modeled. The acre-feet quantified are associated with eight of the projects, and meet the potential needs of the energy industry. The total newly quantified acre-feet adds up to 201,000 acre-feet to meet M&I needs.⁶⁸ In conclusion, the BIP identified projects that meet future M&I demands.

Meeting Colorado's agricultural needs

The agricultural gap is defined as the difference between what a basin indicates it wants to achieve considering agriculture, as defined in its goals and measurable outcomes, and what projects and methods it has determined could be implemented to meet those needs.⁶⁹ While every basin indicated that maintaining viable agriculture is one of the most important aspects of its BIP, this definition allows for considerable variability between basins, which face different issues related to agriculture.

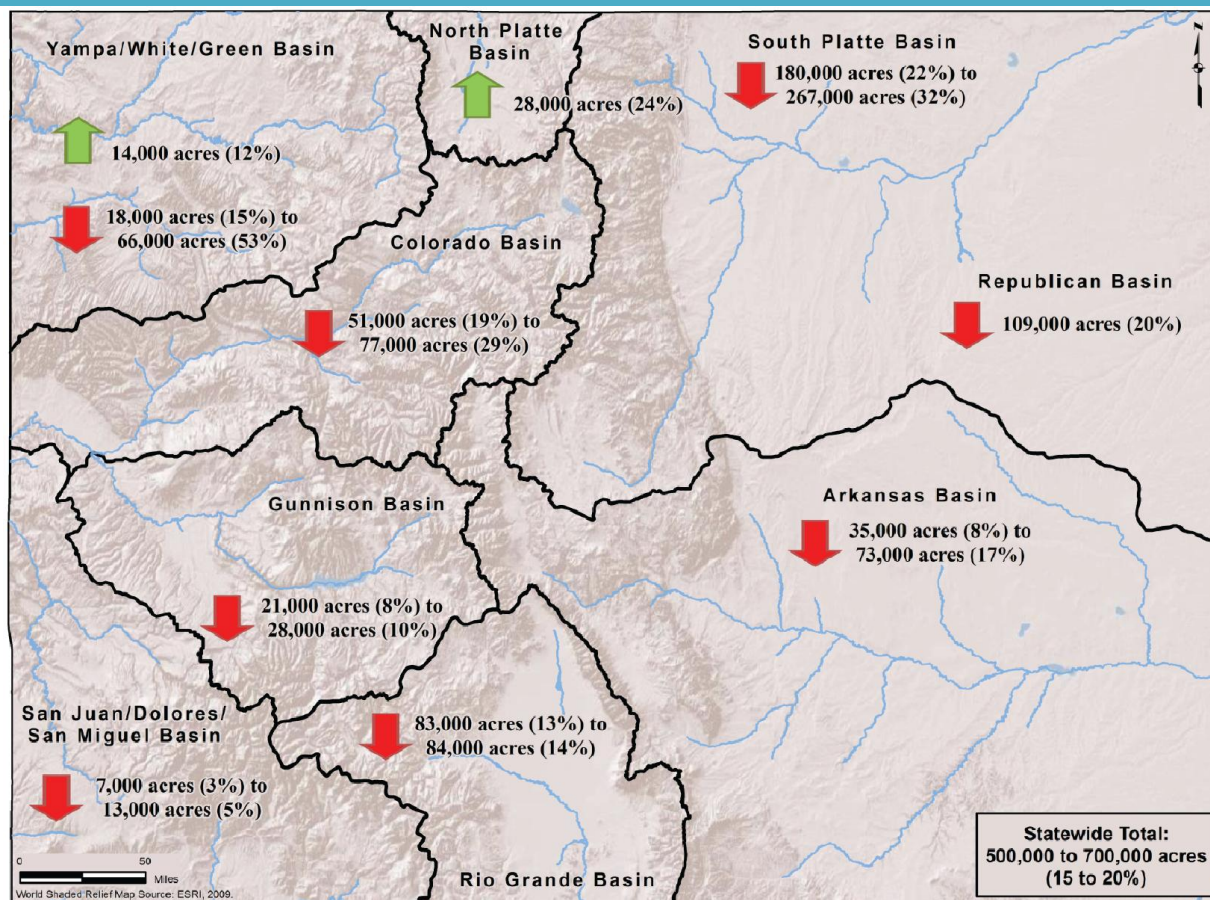
Colorado's irrigated acres are expected to decline in almost every basin by 2050 (Figure 6.2-2), but these projected declines have differing causes. Similarly, every basin has agricultural shortages. The BIPs work to address these challenges by identifying projects that could reduce shortages, maintain the agricultural economy, and in some cases, increase irrigated acres.

To address the challenges of shortages and declining irrigated acres, the CWCB identified three statewide long-term goals:⁷⁰

- Ensure agriculture remains a viable economic driver in Colorado, supporting food security, jobs, and rural communities while protecting private property rights.
- Meet Colorado's agricultural needs.
- Implement efficiency and conservation measures to maximize beneficial use and production.

Figure 6.2-1 Potential Changes in Irrigated Acres by 2050⁷¹

(▲ = increase in irrigated acres; ▼ = decrease in irrigated acres)



Before exploring how the BIPs developed solutions to meet these and other local goals, it is important to understand some of the statewide issues related to shortages and a decline in irrigated acres. Irrigated acres are expected to decline for three primary reasons:⁷²

1. Urbanization of agricultural lands, which is primarily an issue in the South Platte and Colorado Basins;
2. Conversion of agricultural water rights to municipal rights to meet future municipal needs, which is mostly occurring in the South Platte, Colorado, and Arkansas Basins; and
3. Voluntary reductions in water use associated with sustainable groundwater supplies and meeting compact obligations, which is ongoing in the Rio Grande and Republican Basins.

Underlying many of the reasons for agricultural decline are temporary and downward state, national, and international agricultural economic trends. However, by 2050 the agricultural economy is expected to be increasingly viable because of a global increase in the number of people who need food, and also those who can afford high quality and high-protein agricultural products.⁷³ Colorado's agricultural production is also vital locally. As described in Chapter 3, in some counties 50 percent of jobs are related to agriculture.

From a statewide perspective, it is important to provide options and incentives that help maintain or even increase Colorado's agricultural economy and production in the face of losing irrigated

acres. The difference between the status quo, which shows a reduction in irrigated acres in almost every basin (see figure 6.2-1), and the strategic position Colorado and the basins would like to be in from an agricultural perspective in 2050 is the “agricultural gap.” Nevertheless, quantifying this prospective agricultural gap is difficult, resulting in many basins choosing to reduce agricultural shortages or find alternative sources of water so that the transfer of agricultural water is not the default solution to meet Colorado’s growing needs.

Several basins discuss reducing shortages, and it is therefore important to understand how an agricultural shortage is defined. As described in the Gunnison BIP, agricultural shortages can be caused by three primary factors:⁷⁴

Physical shortages are because of lack of physical supply. Such shortages are often seen later in the irrigation season principally by irrigators on smaller tributaries. Though irrigation water rights may be in priority, there is not enough supply. Although these shortages are exacerbated in dry years, on many of the tributaries physical flow is not sufficient to meet the crop irrigation requirement (CIR) for the entire growing season even in wet years.

Legal shortages are those because of lack of legal supply; there may be physical supply at a headgate, but it must be bypassed to meet downstream senior water rights. This type of shortage is often seen later in the season by irrigators with junior water rights in average and wet years, and may be the situation for junior irrigators the entire growing season in dry years.

Irrigation Practice “shortages” result from specific irrigation practices; the irrigator may have physically and legally available supply but chooses not to irrigate. For example, some irrigators may need to reduce or cease irrigation to allow the land time to dry before haying or grazing. In addition, an irrigator may cease diverting because there is not enough time left in the growing season for an additional cutting. Note, though this [is] a very different type of shortage, it is equally important to document. Identification of shortages related to irrigation practices helps to quantify the difference between CIR and actual consumptive use in SWSI and other statewide planning efforts. In addition, since irrigation practice shortages cannot be addressed by increased water supply, their identification helps to focus on the implementation of projects that meet physical and legal shortages.

Due to economic viability, irrigation practice “shortages,” and other factors, an agricultural shortage is not necessarily an agricultural gap. Colorado continues to have a healthy agricultural economy, despite shortages between 17 and 45 percent statewide.

This subsection reviews information by basin, and table 6.2-3 summarizes the success of each basin in meeting the agricultural gaps they defined through their goals.

Table 6.2-3: Summary of How Each Basin Met its Agricultural Gaps

Basin	Irrigated Acres ⁷⁵	Shortage (acre-feet/year) ⁷⁶	Potential New acre-feet	# of New Projects	Summary of How BIPs Met Their Agricultural Goals / Gap
Arkansas	428,000	30,000 – 50,000 (augmentation gap) ^c	89,000	11	Yes ↓ shortages; potential to sustain agricultural \$1.5B economy w/ actions; not develop specific augmentation water projects; policies and projects support rotational fallowing, policies to support agricultural related recreational and environmental with conservation easements
Colorado	268,000	100,000	453,000 – 483,000	41	Partially ↓ shortages; some efforts to develop incentives and ↓ urbanization and agricultural to urban transfers
Gunnison	272,000	116,000 ⁷⁷	126,209 - 129,384	17	Yes ↓ shortages, partially discourage agricultural transfers through policies
North Platte	117,000	110,000	12,000	12	↑ Irrigated acreage to partially meet 17,000 acre goal; ↑ storage to partially meet 37,000 acre-feet goal
Rio Grande	622,000	428,000	N/A	N/A	Yes, improve infrastructure; partially improve agricultural economy
South Platte	1,381,000 (831,000 SP, 550,000 Republican)	434,000 (160,000 SP, 274,000 Republican)	0	0	Partially ↓ permanent dry up w/ conceptual ATMs & alternative sources, not ↓ urbanization or shortages
Southwest	259,000	198,000	41,354	5	Partially ↓ shortages; Yes, ↑ efficiency w/ IPPs; policy to minimize acres transferred, no agricultural sharing IPPs
Yampa / White / Green	119,000	54,000	24,875	3	↑ Number of irrigated acres to partially meet 15,000acre goal; partially ↓ shortages by 46 %
TOTAL	3,466,000	1,470,000 – 1,490,000	746,438 – 779,613	89	



Arkansas

The Arkansas Basin has the third highest acreage of irrigated land in Colorado and the highest percentage of shortages as a basin (45 percent).⁷⁸ In addition, irrigated acres are likely to decline by eight to seventeen percent.⁷⁹ These declines are primarily because of agricultural transfers from both within the basin and from municipal interests in the South Platte Basin. However, as many as 3,000 (1 percent) irrigated acres could be urbanized as well.

^c The Arkansas Basin roundtable aspires to maintain the agricultural economy in the basin, and does not identify the agricultural gap in terms of irrigated acreage. Under the Arkansas River Compact, consumptive use is limited, so the roundtable believes that a gap expressed in terms of an “augmentation gap” is a more appropriate evaluation of needs.

Arkansas goals and measurable outcomes

To address these pressures, the Arkansas BIP identified four goals related to sustaining agriculture.⁸⁰ These goals and the associated measurable outcomes are:

- Sustain an annual \$1.5 billion agricultural economy in the basin.
 - Increase in measured economic productivity by update of Colorado State University study in 2020.
- Provide augmentation water as needed to support increased farm efficiencies.
 - Document the baseline of current augmentation water available.
 - Track available storage facilities for augmentation sources.
- Develop a viable rotating fallow and/or leasing program between agriculture and municipal interests to address drought and provide risk management for agriculture.
 - Report on pilot projects underway as of December 2015.
 - Complete and present report by December 2015.
 - Survey of permanently retired acreage as of year 2020.
- Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land.
 - Measure the economic contribution of tourism to the basin economy within the CSU 2020 update.
 - Change of status for “protected” attributes as measured by nonconsumptive projects and methods in SWSI 2016 report.
- Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.
 - Storage capacity and percentage of stored water annually from 2015 to 2020.
- Annual reporting of projects that have been permitted and/or constructed.

Meeting the Arkansas’ agricultural gap

The primary goal is to support the \$1.5 billion agricultural economy in the face of agricultural loss.⁸¹ As the BIP indicates, a multi-pronged strategy is necessary:

“To maintain that level of economic productivity, projects and methods described in [the BIP] focus on development of rotating fallowing, conservation easements, and increased storage capacity to allow agricultural water to sustain agricultural productivity. In particular, a three-pronged approach to understanding rotational fallowing within the Prior Appropriation Doctrine is underway – an administrative and accounting tool, pilot projects and public policy dialogue – and will continue.”⁸²

The Arkansas Basin has identified seven projects focusing primarily on agricultural and four focusing on agricultural and M&I needs, with identified acre-feet. If all 2015 IPPs with measurables are implemented the basin would reduce its agriculture gap by 89,000 acre-feet. One of these multipurpose projects, which meets both agricultural and M&I needs, will also irrigate 2,000 new acres. A recent study prepared by Adaptive Resources, Inc. for the Lower Arkansas Valley Water Conservancy District shows that 25,000 to 30,000 acre-feet are needed for augmentation today, growing to more than 50,000 acre-feet by the year 2050. If the basin implements the identified project they will meet the basin’s high defined augmentation agricultural gap.

Actions to meet the basin goal of increasing surface storage available within the basin by 70,000 acre-feet by the Year 2020 include:

- Implement a critical IPP.
- Work with the State Engineer's Office of Dam Safety to identify storage projects for restoration, rehabilitation, and increased capacity.
- Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.

These actions will work to meet both M&I and agricultural gaps.

Actions to meet the basin goal to provide augmentation water as needed to support increased farm efficiencies include:

- Establish long-term sources of augmentation water through leasing, water banks, or interruptible supply agreements.
- Construct recharge facilities to capture and retime fully consumable water supplies.



Colorado

The Colorado Basin has the fifth highest acreage of irrigated land in Colorado and the lowest percentage of shortages as a basin (17 percent).⁸³ In addition, irrigated acres are likely to decline by nineteen to twenty-nine percent.⁸⁴ These declines are primarily because of urbanization, which account for 65 to 80 percent of the

loss, or 40,000 to 50,000 acres. The remaining agricultural loss is because of agricultural to municipal transfers.⁸⁵

Colorado goals and measurable outcomes

To address these pressures, the Colorado BIP identified four goals related to sustaining agriculture.⁸⁶ These goals and the associated measurable outcomes are:

- Reduce agricultural water shortages.
 - Identify multi-purpose storage projects and methods that address the annual 100,000 acre-feet agricultural shortage.
 - Maintain existing irrigated agricultural acreage.
 - Research local agricultural shortage values in the Colorado River Basin.
 - Improve Colorado water law to encourage agricultural water efficiency practices without harming water right value.
 - Establish lease programs for excess water from existing supply projects in the M&I sector or multi-use projects.
- Minimize potential for transfer of agricultural water rights to municipal uses.
 - Identify farm improvements to develop strong sustainable farm economics.
 - Develop a set of quantifiable factors of agriculture pressures that can be measured and evaluated in the future to incentivize production and reduce trends towards transfers.
 - Adopt local land use codes to conserve water and reduce pressures for agricultural water transfers.

- Promote conservation easements with the anticipated result that they will be more widely considered by the agricultural community.
- Develop incentives to support agricultural production.
 - Reimburse agriculture for value added to the environment including, water quality, wildlife, and views capes.
 - Track effectiveness of agricultural incentives in maintaining irrigated acres.
 - Minimize regulatory disincentives such as overly stringent requirements for reservoir construction.
 - Reduce taxes for true self-sustaining agriculture.
 - Develop incentives that encourage continued agricultural production.
- Promote agricultural conservation that maintains agricultural production and viability.
 - Revise Colorado Water Law to allow agricultural conservation and improved efficiency measures without impacting water right value or risk of abandonment.
 - Strive towards a high level of conservation and efficiency within the agricultural industry.

Meeting the Colorado's agricultural gaps

The Colorado BIP identified 21 high-priority projects that meet basin theme 2: sustain agriculture. The high-priority projects quantified 20,272 acre-feet to meet both agricultural and M&I gaps. While this is insufficient to fully address agricultural shortages in the basin, the Colorado BIP Appendix D identified 41 projects with quantifications of acre-feet that could reduce agricultural shortages in the basin by a total of 453,000 to 483,000 acre-feet. These projects could eliminate the 100,000 acre-feet of shortages in the basin. However, neither a spatial nor hydrological analysis has been done to confirm this. Furthermore, it is unclear how many of these projects are likely to be implemented as several do not have active project proponents.

With regard to addressing agricultural losses because of urbanization, the BIP has several suggestions concerning land use. These could have an effect on reducing urbanization, but that effect has not been quantified in the BIP. In addition, the BIP states a need to promote other activities to minimize agricultural loss from water rights transfers, improve agricultural efficiency, and support agricultural production. More detail is needed to make these policies implementable.

In summary, the basin will likely need to implement both high priority and BIP-identified projects to fully address its agricultural shortages and partially address the other listed goals.



Gunnison

The Gunnison Basin has the fourth highest acreage of irrigated land in Colorado and the second lowest percentage of shortages as a basin (20 percent).⁸⁷ In addition, irrigated acres are likely to decline by eight to ten percent.⁸⁸ These declines are primarily because of urbanization, which could take 20,000 to 26,000 acres out of production.⁸⁹

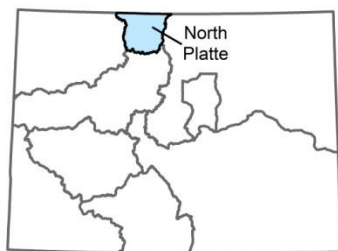
Gunnison goals and measurable outcomes

To address these issues, the Gunnison BIP identified two goals related to sustaining agriculture.⁹⁰ These goals and the associated measurable outcomes are:

- Improve agricultural water supplies to reduce shortages.
 - Reduce basin-wide agricultural shortages by developing 10 projects from the list of recommended solutions in the Gunnison BIP by the year 2030.
 - Implement the Inventory of Irrigation Infrastructure Improvement Needs projects from the list of recommended solutions in the Gunnison BIP by 2020.
- Discourage the conversion of productive agricultural land to all other uses within the context of private property rights.
 - Preserve the current baseline of 183,000 protected acres in the Gunnison Basin and expand the participation in conservation easements by five percent by 2030 through programs like the Gunnison Ranchland Conservation Legacy.

Meeting the Gunnison's agricultural gaps

The Gunnison Basin Roundtable identified 17 projects that it expects to be implemented in the near-term that, if implemented, would reduce shortages in the basin by 126,209 to 129,384 acre-feet. In addition, there are infrastructure improvement projects that may not yield acre-feet, but will improve agricultural efficiencies. The Gunnison BIP also states a goal of protecting more irrigated acres. Currently, out of the 272,000 irrigated acres in the basin, 50,000 are protected through conservation easements and other heritage protection efforts. The Gunnison Basin Roundtable would like to see another 9150 acres protected by 2030, and it is not clear if policies within the BIP will enable this to happen. Therefore, the BIP is considered to partially meet the second goal.



North Platte

The amount of irrigated land in the North Platte Basin has declined since the Supreme Court's Equitable Apportionment Decree, which states that the North Platte in Colorado can continue to irrigate at the historical levels defined in the decree. The North Platte BIP has indicated an interest in irrigating more lands.⁹¹

North Platte goals and measurable outcomes

To address this issue, the North Platte BIP has two goals related to sustaining agriculture.⁹² These, along with the associated measurable outcomes are:

- Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.
 - Develop three projects from the list of recommended solutions by 2020.
 - Incrementally bring up to 17,000 additional acres under irrigation by 2050.
 - Develop 37,000 acre-feet of additional storage (doubling of current storage) by 2050.

- Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
 - Develop three projects from the list of recommended solutions by 2020.

Meeting the North Platte's agricultural gaps

The North Platte identified 12 projects with estimates of acre-feet, acreage, or cubic feet per second. Six of the projects have water volume information, and half of these do not identify the associated increase in acreage that they would provide. It is estimated that approximately 12,000 acre-feet could be generated from these projects. Similarly, nine potential projects include information on the acreage that could be served, but six descriptions do not include how many acre-feet are associated with the projects. In sum, more than 12,000 acres were identified in the BIP. It is assumed that the three projects without associated acreage would add to this number, but given the available data, about seventy percent of the North Platte BIPs goal to increase acreage is met. Additionally, there are several listed projects that work to restore, maintain, and modernize water infrastructure in the basin. However, the goal to increase storage by 37,000 acre-feet is only partially met by the BIP.



Rio Grande

The Rio Grande Basin has the second highest acreage of irrigated land in Colorado and the basin as a whole uses 67 percent of its crop irrigation water requirement.⁹³ Agriculture is the primary water use and is the base of the economy. At the same time, the water balance must be corrected to achieve sustainability between senior surface water rights and the more junior groundwater rights. To achieve sustainability and protect senior water rights, it is estimated that approximately 15 percent or 80,000 currently irrigated acres may be dried up. These issues are being addressed either by the new rules and regulations being developed by the State Engineer or the formation of groundwater management subdistricts.⁹⁴ The purpose of the rules and regulations is as follows:

The overall objective of this subdistrict plan is to provide a water management alternative to state-imposed regulations that limits the use of irrigation wells within the subdistrict, that is, a system of self-regulation using economic-based incentives that promote responsible irrigation water use and management and insure the protection of senior surface water rights.⁹⁵

Rio Grande goals and measurable outcomes

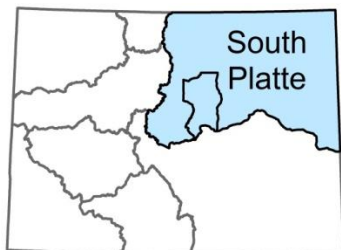
To address these issues, the Rio Grande BIP identified two goals related to sustaining agriculture.⁹⁶ These goals and the relevant measurable outcomes are:

- Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.
 - A database of existing water infrastructure including documentation of infrastructure condition including M&I facilities, storage reservoirs and major ditch diversions is created.
 - Reservoirs operate at full design capacity without restrictions.

- Diversion structures and conveyance systems function optimally.
- Manage water use to sustain an optimal agricultural economy throughout the basin's communities.
 - The cultural heritage of agricultural water use in the San Luis Valley is recognized.
 - Agriculturally supported jobs are sustained.
 - Rangeland is maintained and improved.
 - Soil health is enhanced and soil loss is minimized on both farmland and rangeland.
 - Alternative agriculture practices that improve soil health and/or reduce consumptive use without impacting crop yields are supported and implemented to the extent practicable.

Meeting the Rio Grande's agricultural gaps

As a result of Rio Grande Compact delivery requirements to downstream states and current unsustainable groundwater pumping, the Rio Grande seeks to better manage its agricultural water resources and economy with the formation of groundwater subdistricts that reduce pumping and sustain aquifer levels. Consequently, most of the 15 agricultural related projects analyzed in the Rio Grande BIP do not have new acre-feet associated with them. Six of the projects identified in the BIP focus on monitoring, assessment, and planning. The storage improvement and expansion projects are largely focused on improved augmentation and administration opportunities that would help meet irrigation as well as environmental and recreational water needs. In summary, the Rio Grande's BIP meets its defined agricultural gap.



South Platte/Metro/Republican

The South Platte and Republican River Basins have the highest acreage of irrigated land in Colorado and the percentage of shortages in the region as a whole is 25 percent.⁹⁷ The BIP projects a gap of 160,000 acre-feet in the South Platte and 274,000 acre-feet in the Republican. In addition, irrigated land is likely to decline by 22 to 32 percent in the South Platte Basin and by 20 percent in the Republican

Basin according to SWSI 2010.⁹⁸ The South Platte BIP reexamined potential loss of irrigated lands in the South Platte Basin based on past trends, and indicated a range of 10 to 20 percent for the South Platte Basin.⁹⁹ These declines are primarily because of agricultural-to-municipal transfers, but urbanization is expected to account for six to seven percent of the loss, equivalent to 47,000 to 61,000 acres.¹⁰⁰ In the Republican Basin, the loss of more than 100,000 irrigated acres is related to factors associated with sustainable groundwater and compact related issues.

South Platte goals and measurable outcomes

To address these issues, the South Platte BIP identified one goal related to sustaining agriculture.¹⁰¹ This goal and the associated measurable outcomes are:

- Fully recognize the importance of agriculture to Colorado's future well-being, and support continued success and develop new voluntary measures to sustain irrigated agriculture.
 - Support strategies that reduce traditional permanent dry-up of irrigated land through implementation of other solutions including conservation, reuse, successful

implementation of local IPPs, successful implementation of ATM, and development of new Colorado River supplies.

- Support strategies by municipalities and other local and state land use authorities that reduce loss of irrigated land from urbanization.
- Support strategies to address agricultural water shortages through IPPs, new multi-purpose projects, and innovative measures to maximize use of available water supplies.
- Develop local tools and political/community support for tools to sustain irrigated farmland.
- Encourage maintenance of existing wetlands in focus areas associated with agricultural lands.
- Ensure agricultural dry-up and alternatives take into consideration environmental and recreational focus areas and attributes.

Meeting the South Platte's agricultural gaps

The BIP discusses several strategies to reduce agricultural shortages and minimize permanent agricultural losses. Conceptually, the BIP indicates that 30,000 acre-feet of future municipal demands could be met through ATMs. However, the BIP also lists several barriers to ATMs, which need to be overcome. The BIP also includes recommendations on streamlining transaction costs for ATMs and ATM grant programs that are occurring in the South Platte Basin. In addition, the BIP discusses the need to preserve the option for developing additional TMD water, which would lessen the need for significantly more agricultural transfers to occur. There are no IPPs identified that explicitly address agricultural shortages. The BIP indicates the basin roundtable would like to further investigate options surrounding land use, which could increase urban densities, and therefore reduce the number of agricultural acres that are urbanized. The BIP does not go into depth about developing local political tools or ensuring that environmental and recreational values associated with agriculture are taken into account. Therefore, the BIP is considered to partially meet its goals and measurable outcomes.



Southwest

The basins in the Southwest have the sixth highest acreage of irrigated land in Colorado and the third highest percentage of shortages as a basin (34 percent).¹⁰² In addition, irrigated acres are likely to decline by three to five percent.¹⁰³ These declines are primarily because of urbanization, although if Colorado River supplies are not available, some agricultural to urban transfers may be necessary.¹⁰⁴

Southwest goals and measurable outcomes

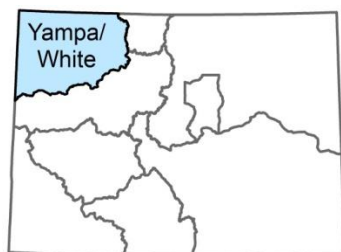
To address these issues, the Southwest BIP identified three goals related to sustaining agriculture.¹⁰⁵ These goals and the associated measurable outcomes are:

- Minimize statewide and basin-wide acres transferred.

- Implement projects (e.g. ATMs, efficiency, among others) to help preserve agriculture and open space values, and to help address municipal, environmental, recreational, and industrial needs; while respecting private property rights.
- Implement strategies that encourage continued agricultural use and discourage permanent dry-up of agricultural lands.
- The water providers in the state that are using dry-up of agricultural land and/or pursuing a new TMD shall have a higher standard of conservation. The goal for these water providers is a ratio of 70-percent use occurs in-house while 30-percent use occurs outside (70/30 ratio).
- Implement efficiency measures to maximize beneficial use and production.
 - Implement at least 10 agricultural water efficiency projects identified as IPPs (by sub-basin).
- Implement IPPs that work towards meeting agricultural water supply shortages.

Meeting the Southwest's agricultural gaps

The Southwest BIP identifies 10 projects that have a combined 40,000 of new acre-feet associated with them, although of these projects only one is not also counted for M&I uses. These identified projects work toward reducing agricultural water supply shortages. As stated in the BIP, there are no identified projects that support agricultural sharing or implement strategies that discourage permanent dry-up of agricultural lands. This is because no agricultural transfers to meet future municipal needs are expected beyond urbanization of agricultural lands. Therefore, the BIP meets its defined agricultural gaps.



Yampa/White/Green

The Yampa, White, and Green River basins have one of the least amount of acres under irrigation of the Colorado basins, and the third lowest percentage of shortages as a basin (23 percent).¹⁰⁶ In addition, irrigated acres could either increase by 12 percent with adequate investment or decrease by 15 to 53 percent.¹⁰⁷ The potential loss of irrigated acres will be determined by whether oil shale or other energy interests grow into a large commercial industry and need to rely on agricultural transfers to meet their needs. Additional declines in irrigated acres are related to urbanization of agricultural lands.¹⁰⁸

Yampa/White/Green goals and measurable outcomes

To address these issues, the Yampa, White, and Green BIP identified two goals related to sustaining agriculture.¹⁰⁹ These goals and the associated measurable outcomes are:

- Improve agricultural water supplies to increase irrigated land and reduce shortages.
 - Reduce agricultural shortages basin-wide by 10 percent by the year 2030.
- Preserve the current baseline of 119,000 irrigated acres and expand by and expand by 12 percent by 2030. Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights.
 - Preserve the current baseline of approximately 119,000 protected acres and expand by 12 percent by 2030.

- Encourage land use policies and community goals that enhance agriculture and agricultural water rights.

Meeting the Yampa/White/Green's agricultural gaps

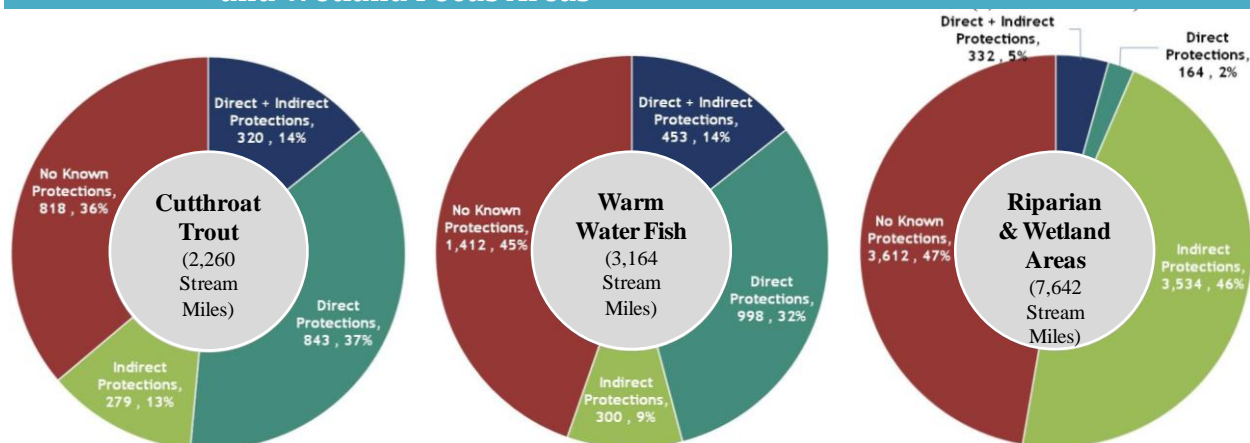
Figure 6.2-1 indicates the modeled level of shortages that still exist within the basin after the BIP's planned projects are implemented in a dry future. There are six agricultural projects proposed in the BIP that include measurable. These estimate almost 25,000 new acre-feet and 41,000 affected acre-feet. These projects not only include the agricultural projects, but also potential energy projects and some municipal projects. The planned energy project would meet much of the needs of a full-scale oil shale industry, and would therefore decrease the potential number of irrigated acres that would need to be transferred for industrial purposes. However, some of these projects could cause additional shortages in the basin, although shortages are significantly reduced in the Yampa River between Craig and Maybell. This area has some of the most significant agricultural land in the basin. In addition, the identified projects would help develop some of the additional acreage planned for in the BIP. While the document stresses the need for land use policies that support agriculture, no specific policies are identified. All in all, the BIP mostly meets its defined agricultural gaps, and the basin roundtable plans to continue to refine this work for the final version.

Meeting Colorado's Environmental and Recreational Needs

The water gap needed for environmental and recreational use is defined as the difference between what a basin indicates it wants to achieve with regard to meeting its environmental and recreational needs, as defined in its goals and measurable outcomes, and what projects and methods it has determined could be implemented to meet those needs.¹¹⁰ While every basin indicated that meeting its environmental and recreational needs is an important aspect of its BIP, this definition allows for considerable variability among basins, which face different issues related to the environment and recreation.

Colorado's environmental and recreational needs can be met through protection or restoration projects and methods. These projects and methods could have flow, habitat, water quality, species connectivity, or non-native species management components. In some cases, senior water rights holders help meet environmental and recreational needs upstream. Because of the diversity of projects and methods that can help the environment and recreation, the water gap is often measured in stream miles. With support from the CWCB, each basin roundtable developed focus area maps as part of their 2011 needs assessments. These indicate where significant species, recreational areas, and other environmental attributes are located. The CWCB then conducted a study to identify and determine the locations of existing and planned projects that meet the needs of some of the environmental and recreational focus areas identified by each basin roundtable. From this data, areas with no known protections can be identified, versus areas with some type of protection (see Figure 6.2-2). This information was mapped and included in the Nonconsumptive Toolbox and an example is shown on Figure 6.2-3.¹¹¹

Figure 6.2-2: Percent of Perennial Stream Miles Statewide with Protection for Cutthroat Trout Species, Warm Water Fish, and Important Riparian and Wetland Focus Areas

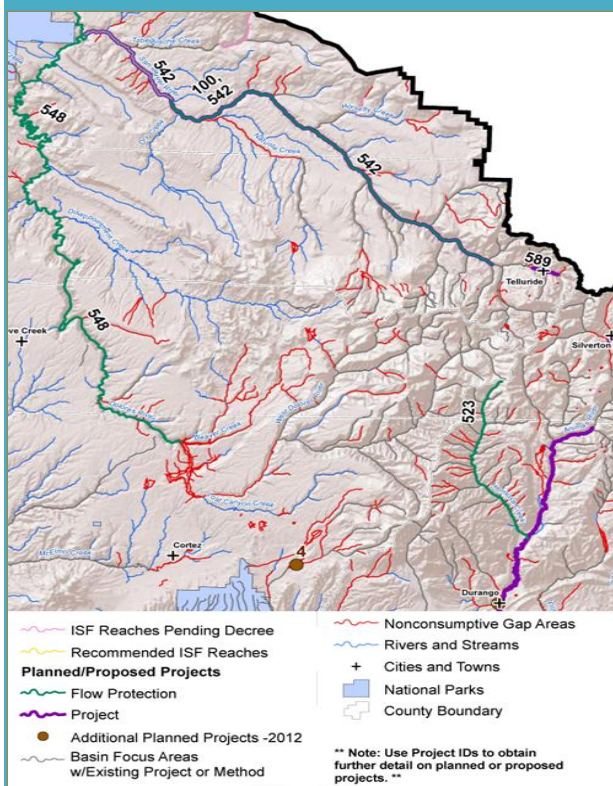


While not every area that has a project or method may be sufficiently protected, and not every stream reach within the focus areas needs protection, these maps provide a good starting point for assessing the locations of potential environmental and recreational gap areas. The CWCB is currently working to further refine this methodology and include the additional projects and methods identified in the BIPs.

To address the challenges in meeting the needs of the environment and recreation, the CWCB identified five statewide long-term goals to accomplish this work:¹¹²

- Promote Restoration, Recovery, and Sustainability of Endangered, Threatened, and Imperiled Aquatic and Riparian Dependent Species and Plant Communities
- Protect and Enhance Economic Values to Local and Statewide Economies Derived from Environmental and Recreational Water Uses, Such as Fishing, Boating, Waterfowl Hunting, Wildlife Watching, Camping, and Hiking
- Support the Development of Multi-Purpose Projects and Methods that Benefit Environmental and Recreational Water Needs as well as Water Needs for Communities or Agriculture
- Protect, Maintain, and Improve

Figure 6.2-3: Nonconsumptive Toolbox



Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self- Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability

- Maintain Watershed Health – Protect or Restore Watershed that Could Affect Critical Infrastructure and/or Environmental and Recreational Areas

Table 6.2-4: Summary of How Each Basin Meets Its Environmental and Recreational Gaps*

*NOTE: The % of streams with no known protections do not represent gaps for specific species or plant communities, which may be larger.

Basin	Focus Area Perennial Stream Miles	No. of Perennial Stream Miles w/ No Known Protections	Number of New Projects w/ Stream mile Info	Quantified Stream Miles w/ New Projects or Methods	Summary of How BIPs Met Their Environmental and Recreational Goals / Gap
Arkansas	3124	1372 (44%)	30	382	IPPs support greenback cutthroat trout, southern red belly dace, Arkansas darter, and other target species
Colorado	1762	844 (48%)	0	None identified	Partially through support of projects and methods; not identify new funding source or how establish regional cooperatives
Gunnison	1106	270 (24%)	0	None identified	Yes, identified: 4 environmental projects, 30 multi-purpose projects, support federally listed endangered fish; explored some alternative funding sources
Metro/ South Platte	959	325 (34%)	0	None identified	The Metro/South Platte Basin support greenback cutthroat trout, boreal toad, common shiner, plains minnow, and other target aquatic species
North Platte	954	231 (24%)	0	None identified	Mostly, identified more than 3 environmental and 2 multi-purpose projects to be implemented; likely increases fishing, waterfowl hunting & viewing by 5 percent if implemented
Rio Grande	2735	397 (15%)	5	4	Partially through project implementation, but quantification of how meet goals and measurable outcomes not performed until final
Southwest	2433	1009 (41%)	9	202	Partially through project implementation, and further quantification of how meet goals and measurable outcomes will be provided
Yampa / White / Green	485	155 (32%)	16	371	Mostly, quantifies and determines many projects that would support the current PBO on the Yampa, new PBO on the White, warm water fish, riparian areas, and recreational boating; integrates consumptive and environmental and recreational interests
TOTAL	13,558	4,601 (34%)	60	577	



Arkansas

In the 2011 needs assessment, the Arkansas Basin Roundtable identified 342 perennial stream miles with Arkansas darter, 371 with greenback cutthroat trout, and 1,811 of important riparian and wetland areas. Very few of the perennial stream miles with Arkansas darter are protected. However, two-thirds of greenback cutthroat trout stream miles have

some level of protection, whether directly through flow protection or aquatic habitat restoration or indirectly through land ownership geared toward wildlife protection or riparian projects. Approximately one-third of riparian and wetland areas identified by the basin roundtable have some level of protection, and most of those are indirect protections. In addition, 57 percent of the identified fishing areas and 22 percent of the identified waterfowl hunting and view areas have some level of protection.

Arkansas' environmental and recreational goals

To address their environmental and recreational needs, the Arkansas BIP established nine goals:¹¹³

- Maintain or improve native fish populations
- Maintain, improve, or restore habitats for fish species
- Maintain or improve recreational fishing opportunities
- Maintain or improve boating opportunities, including kayaking, and other nonmotorized and motorized boating
- Maintain or improve areas of avian (including waterfowl) breeding, migration, and wintering
- Maintain or improve riparian habitat and aquatic habitat, and restore riparian and aquatic habitat that would support environmental features and recreational opportunities
- Maintain or improve wetlands, and restore wetlands that would support environmental features and recreational opportunities
- Maintain, improve, or restore watersheds that could affect environmental and recreational resources
- Improve water quality as it relates to the environment and/or recreation

Meeting the Arkansas' environmental and recreational gaps

The Arkansas BIP has listed 15 environmental and recreationally projects that have identified quantifiable stream improvements. Projects include, but are not limited to water quality improvements, invasive species remove, and fish habitat restoration and passage, across 382 stream miles.

The Nonconsumptive Subcommittee has identified the following priority objectives adapted from previous mapped 12-digit hydrologic unit codes, which outlined areas with high concentrations of environmental and recreational attributes, primarily in three locations: 1) the mainstem Arkansas River upstream of Pueblo; 2) Fountain Creek watershed; and 3) areas around major reservoirs on the Lower Arkansas River between Las Animas and Eads. Priority objectives include:¹¹⁴

- Lake Isabel is an important fishing lake with multiple associated recreational activities that has insufficient water resources to cover evaporative loss. Because of limited water rights,

the lake level has been lowered, thereby diminishing fishing and other recreational opportunities and risking deleterious impacts associated with this reduced water level. It is a priority to obtain additional water rights to allow the lake to be raised to its full, functioning level.

- Grape Creek is an important fishery that runs through the Grape Creek Wilderness Study Area, which adds to its importance as a nonconsumptive resource that has suffered from inadequate flow. Efforts are ongoing with DeWeese-Dye Ditch & Reservoir Company to re-operate the ditch to provide additional water flow through the stream during crucial periods.
- Important wetland resource evaluation needs to be accomplished. Although some information exists on the wetlands in this basin, it is not available basin-wide.
- Chilili Ditch, a canal that runs through the center of Trinidad in Las Animas County, is extremely outdated and in serious need of renovation to improve nonconsumptive resources. This priority would involve a project that addresses both consumptive and nonconsumptive needs, including an update to the ditch diversion to make it fish friendly through the use of fish ladders or other methods that allow fish to move up and down the stream more easily.

The Nonconsumptive Needs Subcommittee will continue to identify priority areas as additional data and information are obtained from current projects and studies, stakeholder input, and from the public.

The basin supports the framework used to evaluate the level of protection a project provides to environmental and recreation attributes as presented in the Gap Analysis Framework.¹¹⁵ Projects identified through the basin's IPPs list will be categorized as Information/Knowledge/ISF/RICD, Implementation, or Stewardship, before using the Framework to analyze the projects to assign levels of protections to individual attributes.¹¹⁶ Not all attributes require protection, and projects and methods may not be necessary at this time for select areas. This analysis will be supported by input from stakeholders, subject matter experts, and basin roundtable members.



Colorado

In the 2011 Needs Assessment, the Colorado Basin Roundtable identified 676 perennial stream miles with Colorado River cutthroat trout, and 435 with imperiled warm water fish, including endangered fish species. An additional 1,098 perennial stream miles of important riparian and wetland areas were also identified. A full two-thirds of the warm water fish species stream miles have some level of protection, much of it direct protection. Three-quarters of Colorado River cutthroat trout stream miles also have some level of protection. Similarly, approximately three-quarters of riparian and wetland areas identified by the basin roundtable have some level of protection; however, most of these protections are indirect. In addition, more than 90 percent of the identified fishing areas have direct protection.

Colorado's environmental and recreational goals

To address their environmental and recreational needs, the Colorado BIP developed the theme to *protect and restore healthy streams, rivers, lakes and riparian areas* and identified five goals. These goals and the associated measurable outcomes are listed below:¹¹⁷

- Protect and rehabilitate healthy rivers, streams, lakes, and riparian areas.
 - A map depicting high priority reaches that have insufficient or poorly timed flows (e.g., 15-Mile Reach, 303(d)) impaired streams, instream flows, monitoring and evaluation reaches, ecologically impacted, recreationally significant, reaches with existing dams.
 - Map or list of reaches where habitat has deteriorated as a result of non-flow related changes and could be restored.
 - Improve habitat conditions in all identified prioritized reaches to mitigate for harm caused by existing or additional water development.
 - Reduce the number of river miles where non-native invasive fish and invasive riparian species have degraded aquatic and riparian communities.
- Define water quality needs and at-risk water bodies (further described in Section 7.3).
- Preserve high quality recreational river and stream reaches with appropriate flows.
 - Maintain number of boater days on 28 reaches identified as recreation priorities by American Whitewater in cooperation with the Watershed Flow Evaluation Tool (WFET) work.
 - Protect access and flow levels for 28 popular recreational reaches.
 - Develop more recreational in-channel diversions (RICDs) structures and water rights on community and basin supported reaches to protect recreational flows.
- Develop a basin-wide funding system to meet basin environmental and recreational needs.
 - Establish a new funding agency or identify an existing agency for the basin or in every county in the basin to fund environmental and recreational management.
 - Leverage existing financial resources to further protect or restore all streams, rivers, and lakes that host prioritized recreational or natural attributes (determine source and scope of funding).
 - Fund the acquisition of conservation easements that retain agricultural purposes and current uses of water.
- Expand regional cooperation efforts to improve efficiencies, provide water supply flexibility, and enhance environmental and recreational amenities.
 - Establish regional water provider, ditch company and environmental and recreational advocate cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects and addressing environmental and recreational needs.
 - Increase permanent interconnects between water providers where feasible.

Meeting the Colorado Basin's environmental and recreational gaps

The BIP identified four top priority projects that are explicitly environmental and recreational projects. The BIP listed 59 total projects, and an additional 13 that address recreational needs and 13 more that address water quality. Many of these are associated with the Colorado River

Cooperative Agreement (CRCA) and the Windy Gap Firing Intergovernmental Agreement. Of these, approximately two thirds are new projects and methods.

The BIP recognizes that a basin-wide stream management plan is a top priority needed to better determine how to advance projects necessary to strategically meet the identified needs. The BIP states, “The most important project identified by the environmental and recreational PLT and the Colorado Basin Roundtable members is to continue assessing the systemic riverine environmental needs of the basin on-the-ground through the creation of a basin-wide stream management plan (SMP). The purpose of a SMP is to provide the framework for maintaining healthy stream systems while also protecting local water uses and planning for future consumptive and nonconsumptive water needs. SMPs identify environmental and recreational flow needs and assist in identifying areas where historical alterations of stream flows most likely affected the ecological resource conditions.”¹¹⁸

The BIP further contends that that “all basins statewide should make protecting and improving the health of our rivers and streams a top priority.”¹¹⁹

At this point in time, it is not clear if the dozens of projects identified would adequately address the environmental and recreational goals and measurable objectives identified, but these projects would at least partially meet the BIPs objectives and a streamflow management plan, if implemented, would likely meet all of the objectives. One of the outstanding issues identified by the BIP is the development of a new funding source within the basin.



Gunnison

In the 2011 Needs Assessment, the Gunnison Basin Roundtable identified 142 perennial stream miles with warm water fish species, including federally-listed species. Of these, more than 80 percent have some level of protection, and most of these stream miles have one or more forms of direct protection. All of the identified 173 perennial stream miles with Colorado River cutthroat trout have some level of protection, with approximately two-thirds of these miles including direct protection. Nearly 90 percent of the 800 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well. However, nearly all of these methods of protection are indirect.

Gunnison Basin's environmental and recreational goals

To address its environmental and recreational needs, the Gunnison BIP identified two goals, which are listed below, along with the associated measurable outcomes:¹²⁰

- Quantify and protect environmental and recreational water uses.
 - Meet identified environmental and recreational needs basin-wide by developing 10 projects from the list of recommended solutions in the Gunnison BIP by the year 2030.
 - Implement the Environmental and Recreational Project Identification and Inventory projects from the list of recommended solutions in the Gunnison BIP by 2020.

- Improve the current baseline of native trout and endangered fish populations in the Gunnison Basin through the year 2050.
- Describe and encourage the beneficial relationship among agricultural, environmental, and recreational water uses.
 - Complete at least five new multi-purpose water projects, including two storage projects, in the Gunnison Basin by 2025 that demonstrate the beneficial relationship among agricultural, environmental, and recreational uses.
 - Explore and develop recommendations on alternative sources of funding from recreational users within the basin to support development of those multi-purpose water projects.

Meeting the Gunnison Basin's environmental and recreational gaps

The BIP reexamined their environmental and recreational needs, and added 27 focus segments. The GBRT added to the 21 segments identified in Phase 2 NCNA process.¹²¹ Many of these segments offer the opportunity for multipurpose projects beneficial to both nonconsumptive and agricultural and municipal interests. Four planned inventory projects in different sub-basins were designed to assess the feasibility of specific potential projects for meeting needs in the focus segments. Within those segments, the BIP explored how well existing programs support the Colorado River Recovery Program for endangered fish species, cutthroat trout and the three imperiled warm water fish species: bluehead sucker, flannelmouth sucker, and roundtail chub.

The BIP indicated that it supports the ongoing recovery program and the reoperation of the Aspinall Unit to meet environmental flow requirements to support these species. This reoperation was first tried in 2014, and will continue to be monitored and adapted to the needs of the endangered fish species. The BIP highlights that non-native fish species are the most significant cause for concern in the Gunnison Basin and recommends “that Colorado explore a must-kill policy for nonnative fish control.”

The BIP indicated that the ongoing work associated with the Colorado River Cutthroat Trout Conservation Strategy adopted by Colorado, Utah, and Wyoming, was likely sufficient to meet cutthroat trout habitat needs.

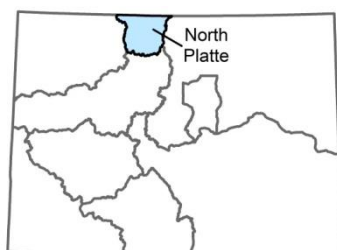
There is an interstate Three Species Agreement in place to protect the three warm water fish species: bluehead sucker, flannelmouth sucker, and roundtail chub, and Colorado Parks and Wildlife is in the process of developing a State Strategy. As part of this work, “it is imperative that fishery managers’ work with water managers to continue to implement the actions articulated in the Three Species Agreement. In the Gunnison, flow protection provided by downstream senior water rights (e.g., the Redlands Water and Power Company water rights) becomes an important means of maintaining the native fishery.”¹²²

In addition to these ongoing efforts, the BIP identified several additional efforts. Out of the 49 projects and methods assigned to tier 1, which are planned to be completed by 2020, 25 have nonconsumptive components that meet one or more of the BIPs identified environmental and recreational goals. The BIP also identified 34 important ongoing environmental and recreational protection and monitoring projects that meet one or more of the goals. Included in the tier 1

projects are many studies that would further develop additional nonconsumptive projects to meet each region's need. The BIP identified several types of projects that could be implemented while preserving existing agricultural uses. These include:¹²³

- Diversion infrastructure improvements that increase accuracy and reduce maintenance costs while preserving stream connectivity.
- Temporary and voluntary instream flow leasing arrangements that sustain flows during critical drought periods.
- Voluntary partial instream flow donations that maintain historical irrigation practices on a more limited basis.
- Multi-purpose storage projects that include operational flow agreements and/or dedicated environmental and recreational flow components.

In summary, if the BIP is fully implemented, the goals and measurable outcomes would be fully satisfied, and the Gunnison Basin would meet its environmental and recreational gaps.



North Platte

In the 2011 Needs Assessment, the North Platte Basin Roundtable identified 222 perennial stream miles with important fishing areas as the roundtable's top priority. Approximately one-third of these miles have some direct protection, and the remaining stream miles have no known protections. There are 93 miles of perennial streams with waterfowl hunting and viewing, 45 percent of which have some form of direct protection. More than a quarter of the 220 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well.

North Platte Basin's environmental and recreational goals

To address its environmental and recreational needs, the North Platte BIP identified two goals. These goals and the associated measurable outcomes are below:¹²⁴

- Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.
 - Increase fishing user days by five percent by 2020.
 - Increase waterfowl hunting and viewing days by five percent by 2020.
 - Develop three projects from the list of recommended solutions by 2020.
- Describe and quantify the nonconsumptive benefits of agricultural use.
 - Complete at least two new multi-purpose water projects in the North Platte Basin by 2025 that meet multiple needs as identified in this report and other studies.

Meeting the North Platte Basin's environmental and recreational gaps

To better determine where the basin roundtable should focus its efforts, the BIP developed a weighted attribute map. The map takes into account both the number of attributes and the priority rank given by the Basin roundtable during the needs assessment process. The BIP states "This map will be used to help target projects to address identified environmental and recreational attributes

in the basin, including both multi-purpose projects and specific environmental and recreational projects.”¹²⁵

The BIP identified 49 planned environmental and recreational projects, three of which are multi-purpose. Out of the list of potential projects, the BIP developed project summaries and methods for 14 projects. Of these, five help maintain healthy rivers and wetlands, and four of these projects also demonstrate the connection among agricultural, environmental, and recreational values. The BIP describes these projects as follows:

The projects include reservoir improvements to preserve a major water supply for the maintenance of habitat at the Arapahoe National Wildlife Refuge, the improvement of a major diversion structure to address fish connectivity while addressing other water user needs, improvement of fisheries habitat at State Wildlife Areas (public access fishing), and two inventory projects that could help identify other multi-purpose project opportunities.¹²⁶

All in all, if implemented, the BIP would address the measurable outcomes that together call for five projects that meet nonconsumptive needs. It is not clear if these projects will reach the fishing and waterfowl hunting targets identified by the BIP. However, the BIP mostly meets its identified environmental and recreational gaps.



Rio Grande

In the 2011 Needs Assessment, the Rio Grande Basin Roundtable identified 564 perennial stream miles with Rio Grande chub, an imperiled fish species. Fifty four percent of the stream miles have some level of protection, most of which is direct. Another warm water imperiled fish species is the Rio Grande sucker, which is listed as state endangered. More than 60 percent of the 346 perennial stream miles that support this species have some level of protection, though more than half of it is indirect. Nearly 40 percent of the identified 748 perennial stream miles with Rio Grande cutthroat trout have some level of protection, although most of this protection is indirect. As of October 2014, the U.S. Fish and Wildlife Service determined that the Rio Grande cutthroat trout is not warranted for listing as “endangered,” and ongoing, extensive recovery efforts will continue for this species. Similarly, just more than 40 percent of the 2,138 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, with most of it direct.

However, in the course of the BIP planning process, the Rio Grande's Environmental and Recreational Subcommittee chose to expand beyond the attributes previously identified in 2011 and undertake a more comprehensive approach that uses updated geographic information system (GIS) layers to determine where key environmental and recreation components exist, to better determine their extent and conditions, to identify where measures are in place to protect or restore those components, and identify where action needs to be taken. Using these methods, the subcommittee has worked to identify the priority environmental and recreational attributes that need additional protection, restoration, or management.

For longer-term projects and methods, the Environmental and Recreational Subcommittee will continue to inventory, update, and quantify environmental attributes in relation to water needs. Through this process, the group will define and update maps of environmental and recreational focus areas in the Rio Grande Basin and develop strategies to address needs and sustain their attributes.

The BIP also indicates that the San Luis Valley has approximately 200,000 acres of internationally important wetlands that provide critical habitat for endangered bird species as well as large numbers of migrating birds and water fowl.

Rio Grande Basin's environmental and recreational goals

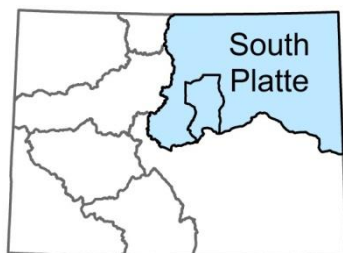
To address its environmental and recreational needs, the Rio Grande BIP identified four goals. These goals and the associated measurable outcomes are below:¹²⁷

- Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the basin.
 - Species that are listed by either the federal or state government as threatened, endangered, or candidate species are recovered or de-listed.
 - Additional species are prevented from being listed by the federal or state government.
 - Economic impact studies for environmental and recreational benefits are considered in the decision-making process for new water supply projects.
 - Wildlife habitat needs are considered in the decision-making process.
 - Natural resource agencies in the San Luis Valley (Rio Grande) coordinate and cooperate with each other to comply with the groundwater rules and regulations and augmentation plans to benefit wildlife and recreation to the largest extent possible.
 - Water needs for wildlife habitat are addressed in plans, databases and San Luis Valley-wide surveys of appropriate wildlife populations.
- Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
 - Identify the needs for properly functioning wetlands and riparian areas.
 - Restore the ecological function of wetlands and riparian areas.
 - Develop and implement projects to restore, conserve, and sustain functioning wetlands, riparian areas, and associated habitats with a focus on incorporating species connectivity.
- Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
 - Negotiate active plans and cooperative agreements that enhance stream flows through re-operations while ensuring full compliance with Colorado water law.
- Maintain and enhance water dependent recreational activities.
 - Floatable flow levels are identified by reach.
 - Cooperative water management provides flows to extend recreational opportunities.

- Recreational facilities are improved and/or enhanced.
- Quality and quantity of fishing opportunities are improved.
- Fish and boat passages are installed where appropriate.
- Conservation pools are rehabilitated, secured and/or conserved as possible.
- Quality and quantity of hunting (e.g., waterfowl, small game, and big game) opportunities are improved.
- Fish hatcheries have sustainable, secure, and adequate physical and legal water supplies.
- Recognize economic benefits of recreation in decision-making processes.

Meeting the Rio Grande Basin's environmental and recreational gaps

Out of the 18 projects analyzed in the Rio Grande BIP, 12 projects help meet the goals identified above. In addition, the BIP will analyze an additional 15 projects that address environmental and recreational information gaps, which will further clarify the environmental and recreational gaps. These projects add a total of almost 410 new stream miles and 60,650 acre-feet. At this point in time, the BIP partially meets its environmental and recreational water gaps.



South Platte (including Metro and Republican)

In the 2011 Needs Assessment, the South Platte and Metro Basin Roundtables identified 628 perennial stream miles with warm water imperiled plains fish species; approximately two-thirds of which have some level of protection. Approximately 90 percent of the 79 perennial stream miles identified with greenback cutthroat trout have some level of protection, although more than half of this protection is indirect. Approximately half of the 628 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, most of it direct. In addition, approximately half of the important fishing areas identified and one-third of the waterfowl hunting and viewing stream miles have some level of protection.

South Platte Basin's environmental and recreational goals

To address its environmental and recreational needs, the South Platte BIP developed a goal, which along with the associated measurable outcomes is listed below:¹²⁸

- Fully recognize the importance of, and support the development of, environmental and recreational projects and multi-purpose projects that support water availability for ecologically and economically important habitats and focus areas.
 - Promote restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic, riparian and wetland dependent species and plant communities:
 - Maintain or increase the habitat for federally and state-listed threatened and endangered species or plant communities.
 - Maintain or increase habitats in the nonconsumptive focus areas with imperiled species or plant communities and secure the species in these

- reaches to the extent possible within the existing legal and water management context.
- Maintain or increase the wetland, lake, or stream habitat used by migratory and breeding birds.
- Develop tools and methodologies to adequately assess what is needed to maintain or increase aquatic, riparian, and wetland habitats throughout the basin.
- Protect and enhance economic values to local and statewide economies derived from environmental and recreational water uses, such as fishing, boating, waterfowl hunting, wildlife watching, camping, and hiking
 - Maintain or increase the surface area, stream miles, or public access for recreational opportunities of high economic value.
 - Maintain or increase the miles and general appearance of trails and greenways to promote aesthetic values and enhance quality of life.
 - Maintain or increase public access to fishing opportunities in lakes and streams.
 - Maintain or increase the total area for birding, waterfowl hunting, and wildlife viewing.
 - Maintain or improve the amount of river miles or flatwater surface acres available to river and flatwater boaters.
 - Develop tools and methodologies to adequately assess what is needed to maintain or improve recreational opportunities derived from ecosystems throughout the basin.
- Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self-Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability
 - Maintain or increase the number of stream miles or surface area of streams, lakes, wetlands, and riparian areas for self-sustaining aquatic species populations, and wetland/riparian habitat.
 - Maintain or improve fish habitat by providing habitat enhancements, eliminating dry up points, and promoting connectivity.
 - Maintain or improve watershed health through source water protection, wildfire mitigation, sedimentation control, and erosion control.
 - Encourage existing and develop new innovative tools to protect instream flows where appropriate.
 - Develop tools and methodologies to adequately assess what is needed to protect, maintain or improve conditions of aquatic, riparian, and wetland habitat throughout the basin.

Meeting the South Platte Basin's environmental and recreational gaps

Through the basin roundtable process, the BIP identified seven additional focus area reaches that were added to the basin needs assessment maps. This work expands the number of areas where a focus on addressing environmental and recreational needs is important. The BIP also assessed

dry-up points within the South Platte Basin, identifying 15 areas that experience no flows during some years at some points in time. These dry up points affect species connectivity and habitat.

To determine the types of projects needed to address these environmental and recreational concerns, the BIP assessed the types of projects needed in the following regions:

1. Headwater areas (Upper Mountain area)
2. Metro Corridor
3. Boulder/Fort Collins (Northern Area)
4. Plains (Lower South Platte)

For each of these regions a suite of project types (e.g., instream flows, stewardship projects, species reintroduction, fish passages, modification or improvements to dry-up points or diversion structures that inhibit fish passage, stewardship programs, and instream flow programs with water rights components that dedicate historic consumptive use to a downstream user while improving streamflows within a reach of concern) were developed and the number of miles with existing or planned protections was assessed. Only three of these projects included measurable in the BIP. Collectively they included 1000 new acre-feet and 1 stream mile.

To move forward with addressing the South Platte Basin's environmental and recreational needs, several recommendations are provided throughout the BIP. Some of these include:¹²⁹

- Proactively pursue projects to maintain and enhance the recreational and environmental attributes in the South Platte Basin.
- Ensure that environmental and recreational attributes are protected or potentially enhanced by multi-purpose and collaborative projects through cooperation with M&I and agricultural users.
- Work to meet the M&I gap, while minimizing the effects on agricultural uses, while also providing protections and enhancements to environmental and recreational attributes in candidate focus areas.
- Provide reliable funding sources to assist with environmental and recreational projects, which is essential for projects to move forward. Some of these funding sources include assisting with a portion of the funding needed for multi-purpose projects so that environmental and recreational stakeholders can be a partner on such projects.
- Further develop, investigate, and document projects and methods and the presence and sufficiency of those projects and methods to enhance and protect environmental and recreational attributes.

The South Platte and Metro Basin Roundtables have a grant to continue further developing the environmental and recreational components of their BIP. They plan to address several data gaps and further explore projects that could meet the needs of the basin. The current BIP partially meets the environmental and recreational gaps identified through the goals and measurable outcomes process.



Southwest

In the 2011 Needs Assessment, the Southwest Basin Roundtable identified 834 perennial stream miles with imperiled warm water fish species, including the flannelmouth sucker, bluehead sucker, and roundtail chub. The CWCB's work in 2011 indicates that nearly two-thirds of these stream miles have or plan to have some level of protection, although most of these are indirect. Approximately 70 percent of the identified 178 perennial stream miles with Colorado River cutthroat trout have some level of protection, and most of this protection is also indirect. Just less than 60 percent of the 762 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, all of which is direct. The Needs Assessment report also identified various forms of recreation, such as fishing, waterfowl hunting, and viewing. Very few stream miles have identified protections for these values.

Southwest Basin's environmental and recreational goals

To address its environmental and recreational needs, the Southwest BIP identified three goals. These goals and the associated measurable outcomes are below:¹³⁰

- Maintain, protect, and enhance recreational values and the value to local and statewide economies derived from recreational water uses such as fishing, boating, hunting, wildlife watching, camping, and hiking.
 - Implement 10 IPPs to benefit recreational values and the economic value they provide.
 - At least 80 percent of the areas with recreational opportunities have existing or planned IPPs that secure these opportunities and supporting flows/lake levels within the contemporary legal and water management context. Based on the map of recreational attributes generated for SWSI 2010, 80 percent of each specific value equates to approximately 428 miles of whitewater boating, 185 miles of flat- water boating, 4 miles of Gold medal Trout Streams, 545 miles of other fishing streams and lakes, 3 miles of Audubon Important Bird Area, 143 miles of waterfowl hunting/viewing parcels, and 6 miles of Ducks Unlimited projects.
 - Address recreational data needs.
- Encourage and support restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian-dependent species and plant communities.
 - Implement 15 IPPs to directly restore, recover, or sustain endangered, threatened, and sensitive aquatic and riparian-dependent species and plant communities.
 - At least 95 percent of the areas with federally-listed water dependent species have existing or planned IPPs that secure the species in these reaches to the extent possible within the existing legal and water management context.
 - At least 90 percent of areas with identified sensitive species (other than Endangered Species Act species) have existing or planned IPPs that provide direct protection to these values. Based on the map of environmental attributes generated for SWSI 2010, this 90 percent of areas with identified sensitive species equates to individual species as approximately 169 miles for Colorado River cutthroat trout, 483 miles for

roundtail chub, 794 miles for bluehead sucker, 700 miles for flannelmouth sucker, 724 miles for river otter, 122 miles for northern leopard frog, 921 miles for active bald eagle nesting areas, and 229 miles for rare plants.

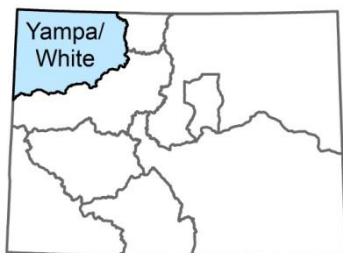
- Protect, maintain, monitor, and improve the condition and natural function of streams, lakes, wetlands, and riparian areas to promote self-sustaining fisheries, and to support native species and functional habitat in the long-term, and adapt to changing conditions.
 - Implement 26 IPPs to benefit the condition of fisheries and riparian/wetland habitat.
 - At least 80 percent of areas with environmental values have existing or planned IPPs that provide direct protection to these values.

Meeting the Southwest Basin's environmental and recreational gaps

The Southwest BIP identified nine environmental and recreational projects and methods that included stream mile information, which cover more than 200 miles of stream. This is a subset of the 12 environmental and recreational or multiuse projects identified with any included measurables; however the Southwest Basin indicates that they can provide additional stream mile information. If implemented, these projects are sufficient to meet the number of IPPs the BIP has identified in the above categories. However, an analysis of the extent to which these projects meet the stream mile goals has not yet been conducted.¹³¹ In addition, the BIP identified two efforts that would extend across the sub-basin to better identify environmental and recreational needs:

1. Evaluation of environmental and/or recreational gaps is planned to be conducted for improvement of non-consumptive resources and/or in collaborative with development of consumptive IPPs. The evaluations may be conducted by a subgroup of the roundtable or by individuals, groups, or organizations with input from the roundtable. The evaluation may use methodologies such as the Southwest attributes map, Flow Evaluation Tool, R2Cross, and any other tools that may be available.
2. Where environmental and/or recreational gaps are identified, a collaborative effort will be initiated to develop innovative tools to protect water identified as necessary to address these gaps.

Until additional stream mile information associated with the identified projects and methods is provided, it is unclear how well the BIP meets its measurable outcomes.



Yampa/White/Green

In the 2011 Needs Assessment, the Yampa, White, and Green Basin Roundtable identified 218 perennial stream miles with state imperiled warm water fish species, and 142 miles with federally-listed warm water fish species. Approximately 55 percent of these stream miles have some level of protection, with most of it direct. Nearly two-thirds of the identified 35 perennial stream miles

with Colorado River cutthroat trout have some level of protection, although most of this protection is indirect. More than three-quarters of the 275 miles of identified perennial stream miles with

important riparian and wetland areas have some level of protection as well, with nearly all of it direct. The Needs Assessment report also identified various forms of recreation. Very few stream miles have identified protections for these values.

Yampa/White/Green Basin's environmental and recreational goals

To address its environmental and recreational needs, the Yampa/White/Green BIP identified two goals. These goals and the relevant measurable outcomes and processes are below:¹³²

- Quantify and protect non-consumptive water uses.
 - To the extent that non-consumptive needs can be specified and projects can be analyzed, there will be projects for non-consumptive attributes within the existing legal and water management context.
 - Multi-purpose projects and methods will be researched and designed to meet the other goals enumerated here.
 - The Programmatic Biological Opinion (PBO) and its depletion coverage for the Yampa River Basin for existing and future expected and unexpected depletions will meet base flow targets in critical habitat areas and assist with endangered fish recovery.
 - A new PBO is agreed upon for the White River Basin that provides certainty for existing and future anticipated and unanticipated depletions and that assists with endangered fish recovery.
 - The flow protection and any water leasing or re-operation of projects needed for native warm water fish, for cottonwoods, and for recreational boating on reaches with greater and overlapping flow alteration risks are integrated with the flow protection for endangered fish recovery and with projects to meet in-basin, consumptive needs. The flow needs of these non-consumptive attributes are otherwise met, including the avoidance of or offsetting the loss of minimum or optimal boating days that are related to multi-purpose projects and unrelated to drier or wetter hydrology.
 - The flow needs for all other non-consumptive attributes are quantified, integrated with projects to meet in-basin consumptive needs, and otherwise met through nonconsumptive IPPs. Multi-purpose projects will be researched and designed to improve riparian or aquatic ecology and bank stability without changing the existing flow regime while voluntarily modernizing irrigation diversion systems and reducing bedload. Similar projects will be researched and designed to improve recreational boating for existing flows while voluntarily modernizing irrigation systems.
 - The economic values of the relatively natural flow regimes of the Yampa and White River systems are recognized and protected, along with the economic values of consumptive water use.
 - Acres of restored riparian areas, degraded streams, and wetlands to restore natural water storage capacity, and improve water quantity and quality for non-consumptive needs.
 - Assess and quantify impact of IPP's on peak flows and ascertain whether further non-consumptive IPP's need to be identified.

- Develop an integrated system of water use, storage, administration, and delivery to reduce water shortages and meet environmental and recreational water needs.
 - Success in permitting and constructing in-basin storage projects.
 - Reduction in consumptive shortages in drought scenarios.
 - Reduction in identified non-consumptive shortages in drought scenarios.
 - Administration and infrastructure improvements making decreed amounts of water available to diversion structures with reduced need for seasonal gravel dams in the river.
 - Reduce the potential incidence of severe low flows in order for water users to exercise their water rights.

Meeting the Yampa/White/Green Basin's environmental and recreational gaps

The previous Watershed Flow Evaluation Tool work examined whether cottonwood, warm water fish, or cold water fish were vulnerable because of flow conditions within the basin roundtable's environmental and recreational focus areas. Additional analysis within the BIP assessed how often instream flows and recreational in-channel diversions were being met throughout the basin. These three efforts provide significant insight into how well environmental and recreational needs are currently being addressed in the basin. Furthermore, the BIP overlaid potential future conditions within the basin to determine how future climate change and developing identified projects and processes would affect:

1. The vulnerability of the species within the environmental and recreational focus areas,
2. The instream flow shortages, and
3. The recreational in channel diversion shortages

For example, the BIP states that “the modeling indicates that the implementation of the IPPs [in a dry future] would increase instream flow shortages by 27 percent on Trout Creek. The development of IPPs could reduce instream flow shortages on the following reaches: Oak Creek (by 1.4 percent, node 582290), Slater Creek (by 3.5 percent, node 542076), and Willow Spring and Pond (by 1.8 percent, node 582162).”¹³³ IPPs appear to have little effect on the environment for most locations (Figure 6.2-4), but could modestly impact endangered fish recovery flows in the Yampa River during the fall and winter (Figure 6.2-5).

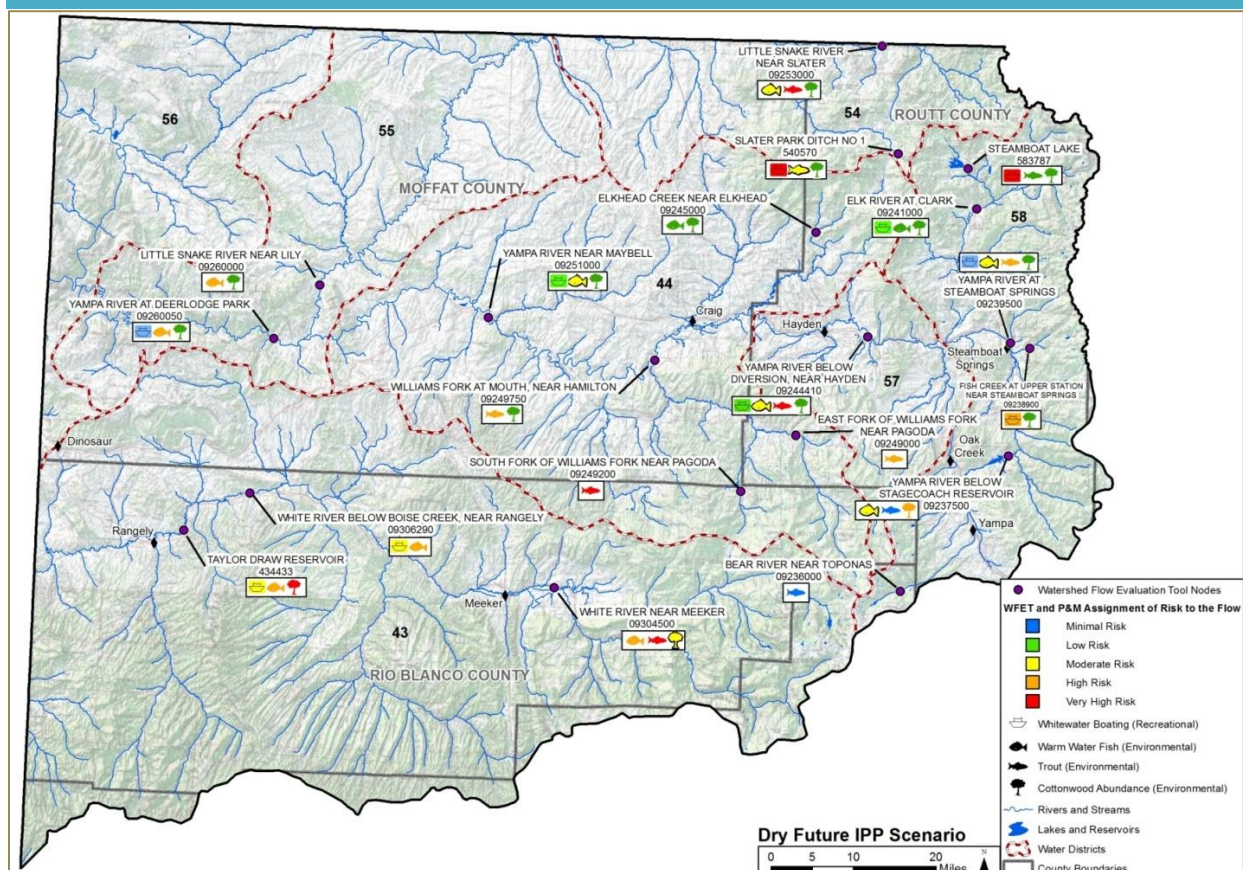
The purpose of this analysis is to provide a course examination of potential environmental and recreational “shortages.” This is the most thorough technical analysis provided in any of the BIPs. In addition the BIP identifies 16 environmental and recreational projects that include a measurable, one of which is an agricultural project with some indentified environmental/recreation benefits. The projects identify a total of 371 new stream miles. As stated in the BIP, “the basin roundtable will continue to explore additional multi-purpose opportunities where they may exist through future planning efforts.”¹³⁴

In summary, the BIP demonstrates progress towards meeting its future environmental and recreational needs and, if implemented, mostly meets the measurable outcomes listed above.

Other BIP Identified Gaps

Other needs identified by the BIPs include those associated with education, watershed health, and water quality. These needs are further explored in Section 9.5, 7.1, and 7.3, respectively.

Figure 6.2-4: Yampa/White/Green BIP- Associated Risk in Dry Future Scenario with IPP Implementation



How other states have worked to meet their gaps

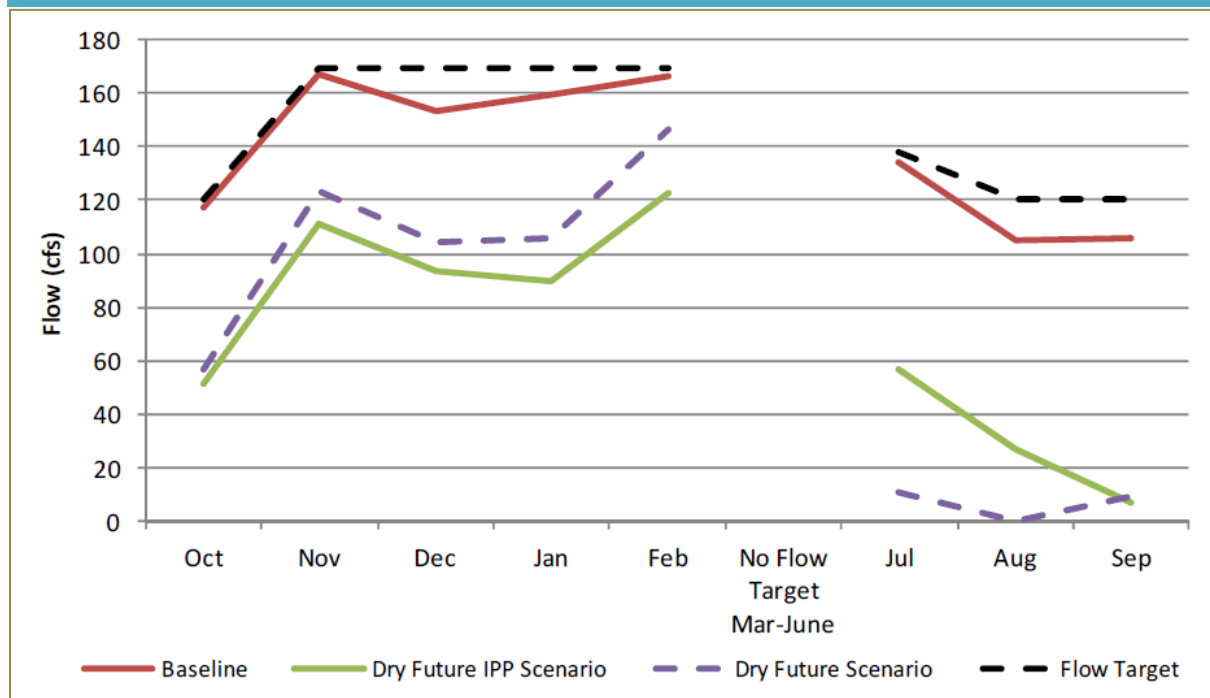
The challenge of meeting future water supply needs is not unique to Colorado's boundaries. Other states across the west are facing the challenge of increased population and potentially limited water supplies. Other neighboring states have also undertaken water planning efforts, for better certainty at the intra and inter-state level.

State and federal water projects account for a substantial portion of the ongoing efforts around the west: for example, California's State Water Project, the Central Arizona Project, and the Lake Powell Pipeline all represent massive financial and political undertakings, with the goal of meeting future water supply needs. Other efforts include water banking, with efforts underway in California. A key issue in the west is also the settlement of water rights issues with tribes located throughout several states. Existing settlements in New Mexico and Arizona have provided a greater certainty to tribes

and to water management agencies within the state. The State of Texas has invested large sums of capital into project implementation, Kansas has invested in Corps sponsored projects for storage, and the State of Utah has collaborated with the federal government on the Central Utah Project.

For more information on neighboring states' efforts to close water supply gaps, refer to the Appendix B.

Figure 6.2-5: Demonstration of How the Yampa PBO Could Be Impacted by a Dry Future and a Dry Future with Identified Projects and Methods Implemented



Actions

The projects and methods in the BIPs met many of the identified gaps; however, gaps remain even with the significant efforts identified. To help the BIPs meet their needs, several next steps are needed. The Gunnison BIP summarized many of these next steps and potential actions, and this work has been updated in Table 6.2-5.

One of the primary purposes of Colorado's Water Plan is to address Colorado's water gaps. To accomplish this, several of the next steps and potential actions identified in Table 6.2-5 are discussed throughout the plan:

- Partnerships and cooperative strategies are vital to overcoming conflict and building local consensus so that a project can move forward. This approach is further discussed in Section 9.4 on more effective and efficient permitting.
- Public education and outreach can also help inform people of Colorado's water needs and solutions. Section 9.5 explores avenues to better support this type of water education throughout Colorado.

- Incentive-based programs are mentioned throughout many sections of Colorado's Water Plan. For instance, Section 6.3 explores opportunities to encourage conservation, reuse, and water-wise land use practices. Section 6.4 explores opportunities to encourage ATMs.
- Funding is also a common theme throughout many of the BIPs. Funding options are further explored in Section 9.2.
- Permitting and other regulatory concerns are also expressed in many of the BIPs, and Section 9.4 explores how to make these processes more effective and efficient.

Table 6.2-5: Strategies for Implementation of the BIPs

Category	Constraint	Next Steps and Potential Actions
Project Evaluation	Conflict	<ul style="list-style-type: none"> • Partnerships • Cooperative Strategies
	Perception	<ul style="list-style-type: none"> • Public Education and Outreach • Incentive-Based Programs
	Regulations	<ul style="list-style-type: none"> • Cooperative Strategies • Effective and Efficient Permitting
Project Feasibility	Cost	<ul style="list-style-type: none"> • Creative Funding Mechanisms • Partnerships and Cooperative Strategies
	Water Availability	<ul style="list-style-type: none"> • Water Availability Analyses • Water Administrative Strategies
	Constructability	<ul style="list-style-type: none"> • Feasibility Analyses • Engineering Design

Colorado's water gaps must be identified and addressed. The CWCB will take the following steps to accomplish this beginning in 2016:

1. The CWCB will support the evaluation, feasibility, and completion of the BIPs through WSRA grants.
2. The CWCB will support increased consistency and technical support in the BIPs in the following ways:
 - Provide technical support for several of the BIPs through continued decision support development and maintenance to explore municipal, agricultural, industrial, and environmental shortage analyses similar to those found in the Yampa/White/Green BIP.
 - Provide technical support for several of the BIPs to explore the use of project information sheets and project tiering, similar to the Rio Grande, North Platte, and Gunnison BIPs.
 - Support the further quantification of costs associated with projects and methods, new acre-feet developed, new irrigated acres developed, and new stream miles protected.

3. The CWCB will incorporate the BIP information into the next version of SWSI and will reassess the municipal, industrial, environmental, recreational, and agricultural gaps at that time.
4. The CWCB will establish guidelines for basin roundtable WSRA grants that will enable the basin roundtables to facilitate implementation of their BIPs in their basin. The purpose of the grants would be to foster meeting municipal, industrial, agricultural, environmental, and recreational needs in a manner consistent with the BIPs.

6.3 Water Conservation and Reuse

Colorado's Water Plan promotes technical and financial assistance throughout Colorado to plan and implement long-term water efficiency strategies to meet local and statewide water needs, and achieve the following statewide long-term goals:

- Reduce overall future water needs through cost-effective water efficiency measures;
- Integrate water efficiency planning and projects into overall water resource management;
- Promote water efficiency ethic throughout Colorado;
- Explore additional water reuse options;
- Further integrate land use and water planning;
- Seek creative options for improving agricultural irrigation conservation and efficiency

Introduction

Water conservation activities and water reuse will play an important role in balancing the need for additional water supply with strategies to lessen that need. By implementing a comprehensive statewide approach for water conservation and water reuse activities, programs from the local level up to the state level will be strengthened. Much like trans-mountain diversions, agricultural water transfers, and storage, conservation and reuse are not “silver-bullets”, however they are critical components to address future needs. Conservation and reuse will be bolstered by creating scalable technical resources, supporting local initiatives through financial incentives, and sharing best-practices.

This section examines water conservation, reuse, land use, agricultural water conservation, self-supplied industrial (SSI) conservation, and state agency conservation. These various water management strategies will help Colorado close the water-supply gap, while at the same time minimizing trade-offs that could result from other solutions. Increased conservation, reuse, and better integration of land-use and water planning will help maintain a healthy environment, promote livable and sustainable cities, and preserve agricultural production into the future.

6.3.1 Municipal Water Conservation

Governor John Hickenlooper stated that “Every conversation about water should start with conservation.”¹³⁵ Water providers and municipalities have progressed in water conservation over the last decade, as was seen in Chapter 5. Building on those efforts, future actions will define which direction Colorado takes to close the supply and demand gap.

Benefits of Water Conservation

Water savings achieved through water efficiency activities can reduce water demands, assisting providers in avoiding, downsizing, or postponing the construction and operation of water supply facilities and wastewater facilities, as well as eliminating, reducing, or postponing water purchases.

In addition to these water supply benefits, other societal, political, and environmental benefits can be achieved including:¹³⁶

- Reducing wastewater discharges through indoor water savings, which can improve water quality and aquatic habitat.
- Reducing outdoor irrigation runoff, which can improve water quality.
- Demonstrating a commitment to sustainability.
- Meeting political and regulatory requirements necessary to obtain permitting for local and regional water supply projects.
- Delaying capital costs for new projects.

Conservation also acts as a management tool to buffer against drought through conservation over the long-term and implementing short term conservation strategies when there are shortages. The amount of water realized through long-term water conservation efforts could be stored as a drought reserve to be used during periods of shortages. In these cases, more storage may be required to maintain a drought reserve.¹³⁷

The use of funds to implement water conservation activities statewide is a wise investment because these are some of the most inexpensive strategies that can be implemented today and will allow local water providers to be more efficient with the water resources they already have.

Water Conservation in Colorado

Municipalities have done a remarkable job in the past decade reducing per capita water needs. Statewide, this amounts to just under twenty percent, but some municipalities have reduced their per capita water use by as much as 30 percent.¹³⁸ Most of the largest water providers in Colorado have CWCB approved water conservation plans and most of the M&I statewide demand is accounted for in these approved plans. According to C.R.S. 37-60-126, covered entities, defined as those entities that deliver more than 2,000 acre feet of water annually, are required to have a CWCB approved water conservation plan.

Many water providers adopted best practices, including landscape efficiencies, water loss management, and inclining block rate structures. For example, of the CWCB approved water conservation plans on file, approximately 85 percent of water providers along the Front Range and eastern slope and 77 percent of western slope water providers have tiered rate structures that increasingly cost customers more if they use more than a base amount of water. These tiered rate structures are called inclining block rate structures.¹³⁹

A successful conservation strategy must build on past accomplishments and model examples already in place at a local level across the state. Below are a few examples that highlight some of the best efforts to date:

- **Aurora Water**—Aurora Water has implemented landscape and irrigation standards along with tiered rate structures. Aurora Water also created a customer information system using GIS, an Excel based water use calculator and state-of-the-art communication tools to efficiently focus incentives to specific customers and to collaborate with their customers more closely. Additionally, they have been implementing a successful turf buy back and landscape design assistance program since 2007.

- **Douglas County**—All covered entities in Douglas County have CWCB approved water conservation plans and the majority of the smaller providers manage water conservation activities under a regional water conservation plan. Of the covered entities, all are implementing water conservation best practices. Specifically, the Town of Castle Rock is a leader in water conservation and is implementing best practices such as landscape/irrigation ordinances, landscaper certification requirements, landscape incentives including a turf buy-back program, water budgets based on irrigated landscape area, smart metering with a customer feedback loop, new construction requirements in relation to water conservation, and customer education.
- **Denver Water**—Denver Water has made significant progress through its “Use Only What You Need” campaign over the last eight years. Now Denver Water is customizing water budgets based on irrigated area for their largest commercial customers. Water budgets allow both Denver Water and the customers to know exactly “what they need.” As a result of this new program, schools, park districts and multifamily community associations have already found significant leaks and irrigation clock malfunctions and have identified large areas for future conversion to landscaping other than turf.
- **Greeley, Boulder, Highlands Ranch and Castle Rock**—All of these municipalities adopted water budget rate structures tied to actual water use on a site. Water budgets are rate structures that are derived from indoor use and allocated amounts of water per square foot based on plant requirements and local climate data. Because rates climb steeply if a customer uses more than his or her water budget, these communities use water budgets to manage their summer peak demands while maintaining healthy landscapes.
- **Ute Water/Grand Junction/Clifton**—Starting in 2002, the Grand Valley Water Providers came together to create a drought response plan called Drought Response Information Project or DRIP. The plan was a success and is still active. Modeling this effort, the providers came together again to create a regional water conservation plan. This effort was practical because their systems are interconnected and generally receive the same media.
- **More Regional Plans**—Many communities and water providers are not required by statute to have a CWCB approved conservation plan because of their small size. These small water providers can, however, come together and create savings that equate to more than the sum of their parts.
 - In the lower Arkansas Valley, 38 small water providers came together to create a regional water conservation plan, under guidance from Southeastern Colorado Water Conservancy District, as a roadmap for conservation planning and implementation over the next 50 years. The main impetus behind the plan is to ensure all the water systems are more efficient before connecting to the Arkansas Valley Conduit thus stretching the new supply further.
 - Steamboat Springs completed a community conservation plan that brought together three water providers under a single community plan in 2010.
 - Presently, five communities in the Roaring Fork Watershed (Aspen, Snowmass Village, Basalt, Carbondale, and Glenwood Springs) are creating a regional conservation plan that ties directly into the Roaring Fork Watershed Plan.
- **Other projects—Sterling Ranch Rainwater Harvesting Pilot project**

- The Sterling Ranch Precipitation Harvesting Pilot Study was approved in July 2010 and is currently in its fifth year and is the only pilot project in Colorado. The legislation that authorized the pilot project study allowed for up to three pilot projects in each river basin and up to 10 pilot projects across the state.¹⁴⁰ Sterling Ranch is located in Douglas County within the South Platte Basin. The 3400 acre planned development received final approval from Douglas County on July 10, 2013. Precipitation harvesting systems are being incorporated into the first phase of development and are planned to occur within the next few years. The Sterling Ranch Water Conservation Plan is key to meeting the site's water conservation goals with a substantial planned reduction in water demands. Preliminary estimates indicate that precipitation harvesting on average can supply as much as one third of the irrigation demand for a typical Sterling Ranch water wise home, further reducing Sterling Ranch's reliance on non-renewable water supplies.¹⁴¹

Social Norming/Behavioral Water Efficiency

Much of water conservation is based on human behavior. It requires constant communication and education to make water conservation a standard community practice (also known as social norming) and to directly influence behavior to achieve water conservation results. At the local water provider level, computer and smart metering technology have improved greatly in recent years allowing for a direct link between provider and customer. Through this direct link a water provider can communicate educational messaging such as water consumption targets, water restrictions, and leak detection. The field of social norming or behavioral water efficiency is becoming standard operating procedure for many water providers in Colorado. Fort Collins, Denver Water, Greeley Water, and City of Brighton are all using technology to provide water consumption goals, current usage statistics and comparisons between neighbors to elicit more water efficient behavior change. WaterSmart Software is a leading company in this field of behavioral water efficiency and is working with several Colorado water providers. By sending a personalized *Home Water Report* to a water customer, showing their consumption, how it compares to their neighbors and with customized actions to reduce water use, residential customers can save 5 percent on their water consumption.¹⁴² With Advanced Metering Infrastructure (AMI), this feedback can be delivered daily and even hourly if needed. This communication link does not need to be limited to water efficiency messaging and illustrates the changing relationship between water provider and water customer. Continued financial support and research of the technology and educational programming needed for these types of customer relation/education tools will be an important path toward more efficient water usage and a more water literate water customer base in the future.

Recent Legislation

Partly in response to the work of the basin roundtables and the IBCC, there have been some recent legislative developments in water conservation.

In 2014, the governor signed legislation seeking to identify and quantify the types of best practices that could be used to limit municipal outdoor water conservation and to determine if legislation is needed to facilitate the implementation of those practices. The bill directly refers to the work of the

basin roundtables and the IBCC, stating, “As part of the CWCB’s statewide water supply initiative and the IBCC and basin roundtable process, a “No/Low Regrets Action Plan” has been developed, an important element of which is to establish and implement conservation strategies to extend the ability of existing water supplies to meet increasing needs and thereby minimize agricultural dry-up.”¹⁴³

The fixtures bill became law in 2014.¹⁴⁴ The law phases out less efficient water using fixtures and requires that only WaterSense specified fixtures can be sold in Colorado. These fixtures carry the Environmental Protection Agency (EPA) WaterSense label, are third party certified, and are 20 percent more efficient than existing fixtures. Future technology advances could make fixtures even more efficient. In addition, these fixtures do not cost more than their less-efficient counterparts. The bill’s proponents estimate that long term replacement of indoor fixtures because of the fixtures bill will garner approximately 40,000 acre-feet of savings annually by 2050 and would increase the replacement rate of existing fixtures.¹⁴⁵ The bill is consistent with the IBCC’s 2010 suggestion to require high efficiency fixtures.

In 2015, Colorado enacted a law that provides incentives to encourage more participation in the state precipitation harvesting pilot program.¹⁴⁶ Incentives include a less burdensome substitute water supply planning process. The main incentive is that when calculating required replacements to the stream to account for captured precipitation, the proponent would not have to replace the amount of precipitation that would have been consumed through the historical depletion from natural vegetative cover that is replaced by impervious surfaces of the new development. The proponent may rely on regional factors established by the CWCB that specify the amount of precipitation consumed through evapotranspiration of preexisting natural vegetative cover.

Past Legislation

In 2010, legislation passed that requires most water providers to submit water use and conservation data to the CWCB.¹⁴⁷ This allows quantifying and tracking water conservation activities and water demand. Implementation of this bill began in 2014 and will provide valuable data to the water plan.

In 2010, legislation was signed into law that requires the builder of a new single-family detached residence, for which a buyer is under contract, to offer the buyer a selection of water-saving options, including:

- Water-efficient toilets, lavatory faucets, and showerheads;
- Dishwashers and clothes washers that meet federal EPA energy star program standards if they are to be financed, installed, or sold as upgrades through the home builder;
- If the landscaping is financed, installed, or sold as upgrades through the home builder and maintained by the homeowner, landscape design that follows the Green Industry’s best management practices; and
- Installation of a pressure-reducing valve that limits water pressure in the residence to 60 pounds per square inch.¹⁴⁸

In 2009, a pilot program was authorized that allows for the collection of precipitation from rooftops for nonpotable uses. The program can include up to 10 new residential or mixed-use developments. At present, the Sterling Ranch development in Douglas County is the first and only pilot to begin and is at the beginning of their first construction phase.¹⁴⁹

In 2005, the governor signed legislation that protected water right owners against abandonment of their water right if certain conditions were met. Two conditions refer to “a water conservation program approved by a state agency and a water banking program as provided by law.” While these conditions do not allow for water sharing, the bill does protect a water right holder from losing their right if non-use results from water conservation activities.¹⁵⁰

In 2005, the governor signed legislation that protected homeowners’ property rights in regard to installation of xeriscape landscaping. This legislation amended the law regulating home owner associations, including a provision that invalidates any new or existing covenant or condition that prohibits or discourages a unit owner from employing xeriscape or that requires landscaping to consist exclusively or primarily of turf grass.¹⁵¹

IBCC No-and-Low-Regrets Actions

In 2010, the IBCC Water Conservation Subcommittee developed a list of water conservation strategies that were included in the IBCC letter to the governors.¹⁵² Among the recommendations were many short-term and longer-term conservation actions that ranged from statewide education campaigns to legislation addressing indoor and outdoor water use.

Potential Water Savings
170,000 acre-feet could serve
1.1 million people statewide

In 2013, the IBCC developed the “No and Low Regrets Action Plan” for water conservation. This strategy outlines what minimum level of water conservation should be carried out statewide. The IBCC reached consensus on the need to reach low to medium levels of water conservation regardless of the future scenario, and the near term potential future actions needed to achieve this (Table 6.3.1-1).¹⁵³

Table 6.3.1-1: IBCC Potential Future Actions Summary

1. Improve Tracking and Quantification of Conservation
2. Establish a Statewide Conservation Goal with Intermittent Benchmarks <ol style="list-style-type: none"> Develop general political support for a statewide conservation goal Develop statewide agreement tying conservation to new supply development and agricultural transfers Support local entities in their efforts to outline and report their own approaches to help achieve the statewide goal. Explore best approach to implementation of standards to achieve goal Develop and implement conservation standards
3. Continue to Support Local Implementation of Best Practices <ol style="list-style-type: none"> Continue implementation of state conservation programs Encourage use of levels framework and best practices guidebook
4. Promote Enabling Conditions for Use of Conserved Water <ol style="list-style-type: none"> Maintain and develop storage and infrastructure for the use of conserved water Promote incentives for the use of conserved water Identify and, where possible, resolve legal and administrative barriers to the use of conserved water Identify and explore barriers to sharing conserved water
5. Develop New Incentives for Conservation <ol style="list-style-type: none"> Explore funding options in support of the Water Efficiency Grant Program Develop professional education and certification programs Develop new eligibility requirements for state grants and loans that include certain conservation levels or indications of commitment to conservation Develop conservation standards for communities planning to use agricultural transfers or new supplies for future water needs Develop incentives that incorporate the following concepts: encourage a base level of conservation; assess issues, benefits, and drawbacks of the current definition of "covered entities;" conservation water markets; small community support; permitting incentives
6. Explore Legislative Concepts and Develop Support <ol style="list-style-type: none"> Explore legislative options and support for indoor plumbing code standards Explore legislative options and support for outdoor water efficiency standards Engage in outreach and education efforts to explain the need for legislation; develop political support
7. Implement Education and Outreach Efforts <ol style="list-style-type: none"> Track public attitudes through baseline and ongoing surveys Develop statewide messaging and use focus groups to refine and guide implementation Develop decision-maker outreach strategies Pursue a coordinated media campaign

The minimum amount of water saved through water providers' active conservation efforts is a goal that was identified through three stakeholder processes. The basin roundtables underwent a process to develop portfolios of water solutions to meet future water needs. The IBCC examined these as part of their no and low regrets action plan and determined that low to medium conservation levels defined in SWSI 2010 were needed; and the scenario planning process determined that all of low, or half of medium conservation SWSI active conservation levels, or nearly 170,000 acre-feet will be needed. This is enough water to meet the needs of about 1.1 million people, or thirty percent of all the new people expected to move to Colorado between now and 2050.¹⁵⁴ Recently, the IBCC Conservation Subcommittee developed a stretch goal that goes beyond the no-and-low-regrets actions:

Reduce Colorado's 2050 municipal water demands by 400,000 acre feet statewide.

- **Benefits:** A stretch goal is in the state's best interest as part of a responsible and sustainable water plan.
- **Achieving the Stretch Goal:** High levels of customer participation will result from new regulatory mandates, technology innovations, incentives, and changing customer behaviors

to reduce Colorado's 2050 water demands by 400,000 acre-feet statewide. This level of conservation includes an additional 60,000 acre-feet of demand reduction beyond the no and low regrets recommendations. Based on current conservation plans statewide, the committee believes this is achievable.

- **Implementation**

- **Accountability:** For the goal to be successful, water providers will be encouraged to do comprehensive integrated water resource planning, geared toward implementing the best practices at the higher customer participation levels. This will be part of the necessary requirements to achieve state endorsement of projects, and financial assistance.
- **Best Practice Based:** The goal can only be achieved through the implementation of best management practices at higher customer participation levels. The best management practices will continue to adapt and evolve over time, incorporating innovative technologies, providing opportunities for contribution to these demand reductions
- **Maintain Local Control:** The goal recognizes the importance of local control and flexibility, while encouraging higher levels of conservation and adoption of innovative practices across the state.
- **Monitoring:** Tracking demand reductions as part of future SWSI updates will be necessary.
- **Adaptive Management:** The goal may need to be adapted based on future demand and other factors and incorporated into the portfolios and scenarios over time.

For the goal to be successful, water providers will be encouraged to do comprehensive integrated water-resource planning geared toward implementing the best practices at the higher customer participation levels. This will be part of the requirements to achieve state endorsement of projects and financial assistance.

BIPs

For 2014, each basin roundtable formulated their own implementation plan that includes water conservation goals and activities in addition to already planned projects and methods, use of Colorado River water, and alternatives to agricultural water transfers.

Arkansas Basin

The Arkansas Basin addressed conservation by stating, "Stakeholders should take all actions required to maintain current water supplies and prevent future water supply gaps from increasing." The Arkansas Basin went on to state four goals for meeting municipal water needs:

- Meet the municipal supply gap in each county within the basin;
- Support regional infrastructure development for cost-effective solutions to local water supply gaps;
- Reduce or eliminate Denver Basin groundwater dependence for municipal users; and,
- Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.

To illustrate progress to date, the Arkansas Basin highlighted many of the current water-efficiency activities such as the innovative regional water efficiency planning efforts being carried out by the Southeastern Colorado Water Conservancy District (SECWCD) and the Best Management Practices

Toolkit for providers. The regional efficiency planning efforts brought 47 mostly small water providers under one efficiency plan while using the toolkit to create individual plans for each provider. The toolkit identifies five components: water production and treatment, water distribution, water delivery to customers, customer demand management, and overall water system management as essential areas of water efficiency. As part of this regional effort, SECWCD will implement triennial system-wide water audits of all participants with annual data reporting back to SECWCD. As a solution for preventing future water supply gaps from increasing, attaining the basin goals and aligning with the ongoing regional efficiency plan implementation, the basin listed several projects and recommendations related to water conservation. The projects focus on water loss metering and audits as identified by the CWCB as Foundational Water Efficiency Activities that every water utility should carry out. These include master meter improvements to aid in measuring water flow reliably and properly accounting for water loss using the internationally accepted American Water Works Association M36 Water Loss Methodology. The BIP relates all of current water efficiency activities that are currently being carried out by water providers in the Arkansas Basin such as water loss management, re-evaluation of water rates, landscape water efficiency, adoption of advanced metering infrastructure, indoor fixture and appliance rebates, policies and regulations and customer education.¹⁵⁵

Colorado Basin

The Colorado Basin mapped out Theme 4 as “Encourage a high level of basin-wide conservation” with two goals specifically for M&I water conservation:

- Improve Colorado water law to encourage efficiency, conservation, and reuse; and
- Pursue continued M&I conservation.

These goals are supported by measurable outcomes such as revising Colorado water law to allow more flexibility in promoting stream health through conservation and achieving and sustaining a high level of conservation by all basin water providers. The Colorado Basin identified projects and methods to implement these such as comparing Colorado water law and procedures with other western states to identify alternative practices to facilitate water transfers and various local water conservation efforts happening today and future planned efforts. Additionally, the Colorado Basin created an extensive section with water conservation intertwined with land-use policies. This is described in the land-use section of this chapter (Section 6.3.3).¹⁵⁶

Gunnison Basin

The Gunnison Basin BIP promotes high levels of water conservation. The BIP focused on identifying and addressing M&I shortages. As a way of fulfilling this goal the basin stated that it would, “Promote the development of voluntary regional water conservation plans to help smaller entities (delivering less than an annual 2000 acre-feet) achieve water savings and related reductions in expenses related to treatment, distribution, and infrastructure.”¹⁵⁷

To attain this goal, the plan listed two measurable outcomes for water conservation:

- Reliably meet 100 percent of essential municipal water provider system demands in the basin through the year 2050 and beyond.

Continue the current baseline of effective water conservation programs by covered entities in the basin, with the goal being high levels of conservation savings as defined in SWSI 2010. The Gunnison Basin also identified statewide principles where water efficiency, conservation, and demand management were intertwined throughout several of them. The most salient principle is Principle 5: *Water conservation, demand management, and land-use planning that incorporates water supply factors should be equitably employed statewide.*

To achieve this principle the Gunnison Basin Roundtable believes that the best way to promote statewide water conservation is through incentives and not regulatory methods, and focusing demand management efforts on covered entities. Additionally, local land-use policies and regulations should discourage sprawl, link water supplies to development, and provide incentives for higher-density developments. Two implementation concepts focused on working with other roundtables to carry out this principle and to promote programs encouraging drought tolerant vegetation and discouraging lawn irrigation.¹⁵⁸

The Gunnison Basin describes their Water Conservation Planning Process for the Upper Gunnison Basin as a means of reaching these measurable outcomes and the goal of addressing M&I shortages in the future.¹⁵⁹

North Platte Basin

The North Platte Basin focuses mainly on agricultural and environmental water issues as the municipal need is low because of lack of population. The North Platte Basin Roundtable states that it, “supports the extensive water conservation efforts of major Colorado water providers, and encourages further conservation as permitted by technology, economics, and legislation. The North Platte Basin Roundtable supports a wide variety of water conservation methods including municipal conservation programs, strategic growth and development, and landscape limitations. The North Platte Basin Roundtable believes that the best way to promote statewide water conservation is through incentive-based measures as opposed to regulatory methods.”¹⁶⁰

To maximize water savings and avoid an unnecessary burden on smaller rural water providers, the North Platte Basin Roundtable supports focusing conservation efforts on covered entities by:

- Supporting the use of state funding to provide incentives for reaching municipal conservation and efficiency standards.
- Working with appropriate entities to ensure that statewide conservation strategies and any related legislation allow flexibility to meet the needs of local governments.

A measurable outcome for the North Platte Basin Roundtable for this process would be to:

- Comply with future statewide municipal conservation strategies and any related legislation by 2020 or as appropriate.

No proposed projects are currently identified to address this goal; however, the North Platte Basin Roundtable will remain involved in the ongoing processes of the IBCC and Colorado Water Plan to support the equitable statewide application of municipal water conservation measures.¹⁶¹

Rio Grande Basin

Much like the North Platte Basin, the Rio Grande Basin Roundtable focuses on agricultural water and environmental needs. With that said, the Rio Grande Basin Roundtable does have a goal “to meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.”¹⁶²

For M&I water conservation the Rio Grande Basin Roundtable has several measurable outcomes:

- Minimize per capita per day use to a reasonable level.
- Inventory existing and expected future M&I and environmental and recreational water needs.
- Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing impacts to other uses.¹⁶³

South Platte/Metro Basin

The South Platte/Metro Basin has an overarching theme of continuing “its leadership role in efficient use and management of water”¹⁶⁴ They also have the following goals and measurable outcomes:

- Goal: Continue the South Platte River Basin’s leadership in wise water use.
- MO#1: Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.
- MO#2: Distribute and encourage adoption of “best management practices” as “guidelines” (not standards) for M&I water suppliers to consider in their “provider-controlled” programs recognizing the substantial differences in climates, cultures and economic conditions throughout the South Platte River Basin.
- NC MO#1: Ensure conservation, reuse and drought management plans take into consideration environmental and recreational focus areas and attributes.

The Metro and South Platte Basin focused on demand reductions that could be achieved based on current trends in water conservation best practices and barring future regulation and major land-use changes. The Metro Basin Roundtable recommends that it pursue conservation programs that would reduce per capita water use from a baseline of 155 gallons per capita per day (gpcd) in 2010 to 129 gpcd by 2050. The South Platte Basin Roundtable recommends conservation programs that would reduce per capita water use from a baseline of 188 in 2010 to 146 gpcd by 2050 (Table 6.3.1-2). The South Platte Basin Roundtable believes these goals are aggressive based on the present day state of conservation best practices and the possible societal changes required to exceed these levels.¹⁶⁵

Table 6.3.1-2: South Platte and Metro Basin Conservation Goals						
Measure	Metro			South Platte		
	Baseline 2010	2050	Reduction (%)	Baseline 2010	2050	Reduction (%)
Residential Indoor	43.7	34	22	60.1	40	33
Non-Residential Indoor	37.5	32	15	39.2	33	15
Outdoor	62.8	54	15	73.7	63	15
Water Loss	10.9	9	17	15	10	33
TOTAL	155	129	17%	188	146	22%

The South Platte/Metro Basin shares some examples of future work that will help achieve conservation savings. The South Platte/Metro Basin suggests that “further standardization of the term “per capita water use” and improvement in the understanding of the factors impacting water consumption rates can help the basin and State better understand the ways that conservation programs and reductions in per capita water consumption can help meet supply gaps.”¹⁶⁶

Additionally, the South Platte/Metro Basin states that certain regulatory, rate structure driven, educational, and incentive based approaches will assist in achieving conservation goals. “Providers encourage conservation through water rate designs, education, watering schedules, and rebate programs as well as water waste rules. Finding effective methods to strengthen code requirements and enact stronger land-use regulations will be an important factor in building efficiencies through conservation.”¹⁶⁷

Finally, the South Platte/Metro Basin finished with thoughts on how more water efficiency could occur:

- Greater savings in outdoor water use would require major changes in landscaping that moves beyond just efficiency measures; this would involve lifestyle considerations about our urban environments. These decisions must be made and implemented at the broader community level, as well as at the water-planner level.
- Higher levels of indoor conservation will require broad political and public support.
- Land-use planning has the potential to promote densification, growth management, and comprehensive plans to include considerations for impact fees and firm yield.

The Metro and South Platte Basin Roundtables support ongoing statewide education to address these factors.¹⁶⁸

Southwest Basin

The Southwest Basin has a “goal of promoting and incentivizing wise and efficient water use through implementation of municipal conservation strategies to reduce overall future water needs.”¹⁶⁹The Southwest Basin supports high conservation levels statewide. .

The Southwest Basin stated the following measurable outcomes for the goal of promoting wise and efficient water use through the implementation of municipal conservation strategies to reduce overall future water needs in their BIP:

- Consistently meet 100 percent of residential, commercial, and industrial water system demands identified in SWSI 2010 in each sub-basin, while also encouraging education and conservation to reduce demand.
- Change the ratio of in-house to outside treated water use for municipal and domestic water systems (referred to as water providers herein) from the current ratio of 50 percent in-house use and 50 percent outside use, to 60 percent in-house use and 40 percent outside use (60/40 ratio) for southwest Colorado and the entire State by 2030.
- The water providers in the state that are using dry up of agricultural land (defined as requiring a water court change case) and/or pursuing a new TMD (as defined by IBCC to be a new western slope to eastern slope diversion project) shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.

Specific IPPs were not developed for all possible management and conservation opportunities but overall strategies include:

- Continue to reduce the amount of water needed for municipal, domestic, and industrial purposes through conservation efforts to meet the goal and measureable outcome herein.

Two project concepts that were “identified during the Southwest Basin process were 1) to work with public water suppliers, including municipalities, to assess their current indoor and outdoor water use ratio and to incentivize the attainment of the 60/40 ratio and; 2) the development of irrigation efficiency program.” These are ideas for projects or processes in the basin that do not have an entity that is actively pursuing them yet.¹⁷⁰

Another area where the Southwest Basin proposes water conservation action is in the basin public education and outreach plan. Short term goals “encourage education and conservation to reduce demand, implement information events on water conservation, land-use planning and reuse, and promote wise and efficient use through implementation of municipal conservation strategies to reduce overall future water needs”.¹⁷¹

Yampa/White/Green Basin

The Yampa/White/Green Basin population is projected to nearly triple by the year 2050 and M&I water usage is also expected to nearly double, even with savings from passive conservation. The basin roundtable has identified adequate storage, strong municipal conservation measures and drought plans to address the situation The Yampa/White/Green Basin identifies M&I water conservation as one of the ways to help meet future demands in the basin through processes and measurable outcomes such as:

- Identifying specific locations in the basin where M&I shortages may exist in drought scenarios, quantifying the shortages in time, frequency, and duration.
- Identifying impacts throughout the basin in the context of water shortages (drought and climate change), wildfire, and compact shortage on M&I demands.

- Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency.¹⁷²

Measurable Outcomes

Reliably meet 100 percent of M&I demands in the basin through the year 2050 and beyond.

One water conservation project is identified and quantified in the Yampa/White/Green Basin. The project goal is to reduce projected use by 720 acre-feet by 2035 in Steamboat Springs by reducing per capita demand by 15 percent in the Steamboat Springs municipal water system, through passive conservation and active conservation such as leak detection programs, fixture rebate programs, and reducing landscape irrigation needs.

Actions

The actions described below are based on the IBCCs No and Low Regrets Action Plan, the work of the Water Conservation Technical Advisory Group and the basin roundtables, and utility water conservation plans.

1. **Adopt conservation incentives:** Over the next two years, the CWCB will adopt policies stating that in order to achieve a state endorsement and financial assistance for water management projects, water providers must conduct comprehensive integrated water resource planning geared toward implementing the water conservation best practices at the high customer participation levels.
2. **Support foundational activities for all water providers:** The CWCB will continue to provide funding, technical support, and training workshops to assist water providers with managing their water systems better through techniques such as: water budgets, smart metering, comprehensive water loss management programs, savings tracking and estimating tools, and improved data collection on customer water uses. For example, the CWCB will fund several regional training workshops for water providers in the next year on using the American Water Works Association M36 methodology for Water Audits and Loss Control.
3. **Recommend WaterSense specifications for outdoor irrigation technology:** Through a stakeholder process, the Department of Natural Resources (DNR) will work with the General Assembly to consider adopting WaterSense specifications for outdoor technology at the retail level. These specifications would create a minimum standard that can be adapted easily to accommodate higher efficiency technologies as they are created and certified.
4. **Explore incentives for outdoor water conservation measures:** As part of a broader funding strategy being developed over the next year, the CWCB will work with stakeholders to explore a tax credit program to incentivize retrofitting higher water-use landscapes with lower water-use landscapes and more efficient irrigation systems.
5. **Adopt a stretch goal:** Reduce projected 2050 demands by 400,000 acre feet through active conservation savings. Based on stakeholder work, the CWCB will adopt a “stretch goal” to encourage demand-side innovation that places Colorado at the conservation forefront in a thoughtful way that recognizes and addresses the impacts conservation carries. The CWCB will support a stakeholder process that examines various options, including options for

local providers to establish targets consistent with the IBCC identified stretch goal, while giving appropriate credit for recent strides made in demand reduction.

6. **Water conservation education and outreach:** The CWCB will develop an education and outreach strategy that includes water conservation topics. More detail regarding specific education and outreach recommendations are detailed in Section 9.5. The education and outreach recommendations outlined in Section 9.5 will tie together the other actions illustrated within this section and provide the “why” for carrying out these actions. These efforts will be rooted in each BIP and carried out to address specific issues that occur in each basin. This work will include surveys of public attitudes and partnerships with water providers and other water educators.
7. **Support local water smart ordinances:** Over the next two years, the CWCB will provide trainings that support local regulatory efforts that shape how new construction interacts with water use to accomplish local water conservation goals. For example, local jurisdictions could craft landscape and irrigation ordinances, tap fees that reflect actual water uses, education or certification of landscape professionals, green infrastructure ordinances, and more stringent green construction codes that include higher efficiency fixtures and appliances and water-wise landscapes. This action is further explored in Section 6.3.3.
8. **Evaluation of barriers to green building and infrastructure.** CWCB and CDPHE will work together to determine which state agencies govern green infrastructure and buildings, identify barriers, and work with the appropriate agencies to adapt regulations to allow for graywater, green infrastructure, and other aspects of green developments.
9. **Strengthen Partnerships:** The CWCB will create or renew partnerships between the CWCB and the following groups to reach water conservation goals:
 - a. Local Water Providers and Local Governments- to implement water conservation programs to benefit their water systems. .
 - b. Intra-state government (Department of Local Affairs, DWR, Department of Regulatory Agencies (DORA), and state facilities) to coordinate and implement incentives.
 - c. Green Industry (GreenCO, Irrigation Association, Associated Landscape Contractors of Colorado) to implement efficient landscape installations and maintenance.
 - d. Home Building/Construction (Home Builders Association, LEED, U.S. Green Building Council) to implement water-smart homes.
 - e. Non-Governmental (Colorado WaterWise, Alliance for Water Efficiency, Western Resources Advocates, American Water Works Association, Water Research Foundation) to help educate Coloradans and further conservation innovations and research.
 - f. Academia (Colorado State University, CU-Boulder, CU-Denver, One World One Water Center-Metropolitan State) Bring a consortium of businesses, academia, etc. to examine behavioral science and research conservation innovations.
10. **Explore expanding conservation funding:** As Colorado water providers implement more sophisticated and integrated water conservation programs, annual funding for the Water

Efficiency Grant Program will be required beyond current levels of \$500,000, and should consistently total \$2,000,000 per year. In addition, the CWCB's loaning ability should be expanded to encompass conservation actions. The DNR will work with the General Assembly to institute these changes over the next two legislative cycles.

11. **Market for conserved consumptive use water:** To use conserved consumptive use water to the greatest extent possible, the CWCB will investigate legal and administrative barriers to the use or sharing of conserved consumptive use water through a stakeholder process. If barriers can be addressed through acceptable legislative modification, the DNR will work with the Water Resources Review Committee to propose legislative action.
12. **Develop an alternative process for smaller entities to create water conservation plans and report water use data to the CWCB:** The CWCB will provide technical and financial support on this and will work to formalize this process into the CWCB Municipal Water Efficiency Guidance document.
13. **Continue implementation of state conservation programs**
 - a. The CWCB will continue reviewing and approving locally adopted water conservation plans to encourage long-term water conservation planning and quantification of water savings, and to ensure that water providers document their water conservation goals.
 - b. The CWCB will continue using the Water Efficiency Grant Fund to ensure the implementation of water conservation best practices and to assist water providers with targeting their resources as efficiently as possible.
 - c. The CWCB will focus on opportunities for water conservation planning in areas where there are covered entities or many small water providers that can create a regional water conservation plan. This will especially be the case when conservation in such communities could help reduce the M&I water supply gap or lessen the need for agricultural dry-up or impacting nonconsumptive values.

6.3.2 Reuse

As mentioned in Chapter 5, there are various sources of water that can be reused to extinction such as: water from transbasin diversions, agricultural-municipal water transfers, and nontributary groundwater. Reuse water will have an impact on future demands and the following describes future actions that will benefit Colorado. There are many innovative reuse projects already in existence and Colorado can also learn from several areas in the United States that are exploring future pathways in reuse technologies.

Nationally and internationally, research has begun to focus on potable reuse systems. In Colorado, most reuse systems have been non-potable in nature. Nevertheless, "de facto" potable reuse occurs where one community discharges to receiving waters that are used by downstream communities for potable supply. This process is controlled by water quality standards in the receiving waters (which drives discharge permits from water reclamation facilities) and Safe Drinking Water Act requirements for potable treatment. Intentional indirect potable reuse (IPR) projects are increasingly common, such as Aurora's Prairie Waters Project and Town of Parker's use of water from its water reclamation facilities to supply Rueter-Hess Reservoir.

Direct potable reuse (DPR) was pioneered through Denver Water's research with its potable reuse demonstration project in the 1980s. Nevertheless, there continues to be public health and environmental concerns related to brine disposal. While it is technically feasible to implement DPR today, it is not fully accepted by the public for reuse as drinking water. More research and education will be needed to gain public acceptance.¹⁷³ In Colorado, no utilities have seriously pursued DPR.

Widespread development of potable reuse will be an important facet of closing the future water supply-demand gap. The CWCBC funded research into zero liquid discharge (ZLD) over the last few years to assess the technology needed to address the challenges associated with managing residuals from advanced treatment of alternative water supplies from lower quality water sources. Most recently, Brighton and La Junta were picked as pilot sites to investigate the feasibility of technologies to minimize or eliminate brine disposal in a manner suitable for Colorado. The study found that the technology produced excellent water quality and had a very high recovery rate of 96 percent and 90 percent for the La Junta and Brighton pilot sites, respectively. Although the technology reduced concentrate and increased water recovery rates, more research must be conducted to reduce costs, increase the reliability of the technology and create a more environmentally friendly technology before widespread adoption can occur in Colorado.¹⁷⁴

On a smaller scale, the Colorado Department of Public Health and Environment's (CDPHE) Water Quality Control Division (WQCD) is authorized to develop Regulation 86 with standards for the use of graywater for consideration by the Water Quality Control Commission (WQCC). Graywater is defined by the bill as wastewater collected within a building from sources other than toilets and urinals, kitchen sinks, dishwashers, and non-laundry utility sinks.¹⁷⁵ Following the promulgation of Regulation 86, and once the Plumbing Board adopts suitable changes, counties and municipalities may adopt local legislation to allow graywater use, subject to water rights restrictions. Graywater use is limited to the uses allowed under the well permit or water right of the original source or sources of the water. Once fully approved, graywater reuse should be an important component of new construction.

In Colorado, reuse water that is used for non potable uses, such as landscape irrigation, is subject to the requirements of Regulation 84, which establishes standards to protect public health and the environment. Reuse water, which is also known as "reclaimed water" is defined in Regulation 84 as "domestic wastewater that has received secondary treatment by a domestic wastewater treatment works and such additional treatment as to enable the wastewater to meet the standards for the approved uses." As briefly described in Chapter 5, Regulation 84 has adapted over the years to accommodate changes and advances in the science of reuse water. Regulation 84 was created in 2000 and has been amended four times since then to add new uses. As Colorado plans its reuse future, continued flexibility will be paramount to addressing water resource challenges. While reusing wastewater can help close the water supply gap, appropriate public health and environmental protections must remain in place. Therefore, Regulation 84 is not the only controlling regulation concerning reclaimed water depending on the use. CDPHE is committed to working with stakeholders to ensure that health and the environment are protected while water reuse expands. Reuse is critical to many municipalities in addressing identified supply gaps in

Colorado, but without significant progress on the ease of implementation, the gains forecasted may not be realistic. New use approval is now a process that can take multiple years and thousands of dollars for uses that are common practice throughout the U.S. and the world. The application of water quality regulations to reuse water will be examined to identify potential change to foster permanent growth in the reuse of limited water supplies.

Currently, while there is not a specific regulatory pathway defined for DPR in Colorado, there are no regulations prohibiting or limiting a utility's pursuit of this option. At present, the Colorado should work through and approve a proposed DPR project. Despite momentum toward more reuse planning and implementation in Colorado, barriers such as public acceptance of DPR and costs of treatment for lower quality water sources are real issues that must be addressed. With this said, development of any new supplies will have implementation barriers as well. These include infrastructure capacities, losses, supply and demand timing, water quality, treatment costs and brine disposal, and regulatory requirements. Many, if not all, of these limitations must also be addressed for many of the new water supplies available to meet future demands, whether transmountain diversions, agricultural transfers, or other. They are not unique to reuse projects. Specifically, brine disposal is a challenge for treating many lower-quality sources with reverse osmosis (RO) – as evidenced by several facilities in the state that use RO to treat groundwater supplies for potable use.

Additionally, the issue of reduced return flows has many water providers and agricultural users concerned about downstream impacts of increased reuse of water supplies. Reuse, like the development of other local supplies through full use of absolute rights or development of conditional water rights may reduce return flows that downstream users have historically relied on. Nevertheless, in combination with other water development, reuse can help mitigate impacts. Future research should be directed toward the possible effects on return flows from the reuse of water.

Recently, the CWCB funded a white paper, "Considering the Implementation of Direct Potable Reuse in Colorado", sponsored by the Water Environment Research Foundation and authored by HDR Engineering. The draft paper explored the technical, operational, regulatory, and public acceptance challenges of implementing DPR in Colorado. In line with Colorado's Water Plan's grassroots approach, Water Environment Research Foundation, the Water Research Foundation and WaterReuse Colorado sponsored a workshop to get feedback on the white paper and discuss direct potable reuse as a new water supply. Reuse experts from across the country attended, including first hand practitioners from Texas, California, and other states. Recommendations from the draft white paper and workshop are as follows:

- Convene a broad range of experts and interested parties to produce a roadmap to develop potable reuse in Colorado. This would include making policy, regulatory, technical, and operational recommendations.
- Sponsor a survey of Colorado utilities and water agencies to determine the extent to which DPR may be considered as a means to augment their water supply portfolios.
- Develop a program to educate the public, elected officials, and water utilities about the benefits and safety of DPR.

- Partner in research projects that advance the knowledge related to technical challenges associated with DPR including more cost-effective and environmentally acceptable RO concentrate management techniques and the evaluation of non-RO based treatment trains capable of producing water suitable for DPR.
- Investigate water quality of de facto reuse situations relative to potable reuse.
- Carry out a state funded potable reuse pilot project in Colorado to assess the impacts and benefits of potable reuse.¹⁷⁶

Some of the results of this work are incorporated into the actions listed below.

Reuse Projects

There are 25 treating reuse providers of direct nonpotable recycled water in Colorado, referred to as “treaters” in Regulation No. 84. Most of these water providers are on the eastern slope along the Front Range. In addition, there are numerous examples of indirect reuse through exchange occurring around the state.

As mentioned in the IBCC’s No/Low Regrets Action Plan, Colorado examples of direct and indirect reuse projects are:

Colorado Springs Utilities: Colorado Springs Utilities has produced reuse water for more than 50 years in the form of direct reuse for irrigation and cooling. Irrigation consists of providing water to golf courses, parks, campuses, and other properties, while cooling water is used for the cooling towers at the Drake Power Plant. According to Colorado Springs Utilities, this has yielded a savings of 1 billion gallons of drinking water per year.

Aurora Water’s Prairie Waters Project: This project employs IPR where Aurora’s fully reusable water is extracted from the South Platte River near Brighton through river bank filtration (RBF) wells, into aquifer recharge and recovery (ARR) basins, and then pumped back through 34 miles of pipeline and three pumping stations providing nearly 1000 feet of lift to the Peter D. Binney Water Purification Facility near Aurora Reservoir. The water is partially treated through natural filtration in the RBF wells and ARR basins, and then fully treated at the Binney facility before mixing with existing water resources and distributing to Aurora’s customers. The current capacity of the system is approximately 10 million gallons per day (MGD), expandable to 50 MGD.

Denver Water: Denver Water has an extensive nonpotable water reuse system that serves many large customers such as Xcel Energy, parks, golf courses, and the Denver Zoo. This recycled water system is a direct reuse system and has a treatment capacity of 30 million gallons per day, expandable to 45 million gallons per day. Denver Water continues to add sites to its nonpotable water distribution network towards its goal of 17,500 acre-feet per year of recycled water use.¹⁷⁷

IBCC No-and-Low-Regrets Actions

In 2013, the IBCC developed the “No and Low Regrets Action Plan” for water reuse. This strategy outlines what minimum level of water reuse should be carried out statewide (Table 6.3.2-1).¹⁷⁸

BIPs

Reuse of water has appeared in a few BIPs where many basins have created the following draft goals.

Arkansas Basin

The same goals of meeting municipal water needs apply in the reuse section as the water conservation section. The Arkansas Basin has the following four goals for meeting municipal water needs that were identified by the roundtable:

- Meet the municipal supply gap in each county within the basin;
- Support regional infrastructure development for cost-effective solutions to local water supply gaps;
- Reduce or eliminate Denver Basin groundwater dependence for municipal users; and,
- Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.¹⁷⁹

Table 6.3.2-1: IBCC No-and-Low-Regrets Actions

Completed and Ongoing Actions	Potential Future Actions
<ul style="list-style-type: none"> • Continue to support current reuse IPPs. • Continue to incorporate reuse in the state water planning process. • Continue the study of zero liquid discharge reverse osmosis plants through the Water Supply Reserve Account (WSRA) program. 	<ol style="list-style-type: none"> 1) Improve Tracking, Quantification, and Planning <ol style="list-style-type: none"> a) Use SWSI efforts to improve reporting of reuse IPPs b) Develop BIPs that incorporate reuse 2) Establish a Statewide Reuse Goal with Intermittent Benchmarks <ol style="list-style-type: none"> a) Develop general political support for a statewide reuse goal b) Develop statewide agreement tying reuse to new supply development and agricultural transfers c) Encourage relevant local entities to outline and report their own approaches to help achieve the statewide goal 3) Develop New Incentives for Reuse <ol style="list-style-type: none"> a) Explore funding options in support of the WSRA grant program b) Pursue breakthroughs in research c) Develop incentives 4) Implement Education and Outreach Efforts <ol style="list-style-type: none"> a) Track public attitudes through baseline and ongoing surveys

While there are reuse projects occurring now in the Arkansas basin, such as the Southern Delivery system, and other reuse projects by Colorado Springs Utilities and Zero Liquid Discharge research in La Junta, the Arkansas Basin has outlined some of the opportunities and constraints for future reuse development. Some opportunities outlined are the creation of additional storage, including the Long-Term Excess Capacity Master Contract space in Pueblo Reservoir, and new reservoirs, which could include a lined gravel pit reservoir below the confluence with Fountain Creek to capture transbasin return flows not immediately exchangeable to Pueblo Reservoir. Constraints consisted of the difficulties of reusing more water in the already over-appropriated Arkansas River

system. The needs will be met from better management of existing supplies that include transbasin water supplies but will need extensive engineering studies and legal support to be done correctly.¹⁸⁰

Colorado Basin

The Colorado Basin is focusing on efforts that include developing water court process recommendations to encourage improvements in efficiency, conservation, and reuse.

This goal is supported by measurable outcomes such as revising Colorado water law to allow more flexibility in promoting stream health through conservation and achieving and sustaining a high level of conservation by all basin water providers. The Colorado Basin identified projects and methods to implement these goals such as comparing Colorado water law and procedures with other Western states to identify alternative practices to facilitate water transfers, and various local water conservation efforts happening today and those planned for the future.¹⁸¹

Gunnison Basin

The Gunnison Basin framed their reuse discussion based on criteria for new supply projects using Colorado River Basin water. Conservation, land use, and reuse are all represented in the criteria. Reuse criteria is stated as, "Entities must first reuse all legally available reusable water supplies to the maximum extent possible before further development of Colorado River System water."¹⁸²

North Platte and Rio Grande Basin

Neither the North Platte nor Rio Grande Basin uses reuse as a future strategy to close their supply gaps because of relatively minor water use by municipal users and low population numbers.

South Platte/Metro Basin

The South Platte/Metro Basin has an overarching theme of continuing "its leadership role in efficient use and management of water"¹⁸³

The South Platte/Metro Basin is viewing reuse water in the context of the Colorado River. Their initial goals state, "A balanced program to plan and preserve options to responsibly develop Colorado River water to benefit both east slope and west slope consumptive and nonconsumptive, environmental and recreational water uses is needed to assure that the State's plan has equal focus on the other three previously identified strategies including: 1) developing IPPs, 2) municipal conservation and reuse, and 3) agricultural transfers."¹⁸⁴

They also have the following goal and measurable outcomes in relation to reuse. The South Platte River Basin will "enhance current levels of municipal water reuse and consider studies to quantify the effects of: 1) additional municipal water conservation on water available for reuse, 2) additional municipal water reuse in relation to water available for exchanges, and 3) reuse and successive uses of water downstream including effects on agricultural water shortages."¹⁸⁵ In relation to non-consumptive needs they will ensure conservation, reuse and drought management plans consider environmental and recreational focus areas and attributes.¹⁸⁶

Table 6.3.2-2: South Platte and Metro Provider's Reuse IPPs

Basin	Providers	Project	Estimated Yield (acre-feet per year)	Estimated Completion Date
Metro	Aurora	Prairie Waters Project Expansion and Storage ^d	TBD	2050
Metro	Northglenn	Northglenn Reuse Plan	700	
Metro	Thornton	Thornton Reuse	2000	2030
Metro	Denver Water	Denver Water Reuse	17,500	2023
Metro	Westminster	Westminster Reclaimed Water		
Metro	Denver Water	Downstream Reservoir Exchanges	12,000	
Metro	Castle Rock	Alternative Northern Water Supply Project	2500	
Metro	Castle Rock	Plum Creek Diversion and Water Purification Facility Upgrades	4100	
Metro	Arapahoe County Water and Wastewater Authority	Reuse of ACWWA Flow Project Deliveries	3250	
Metro	City of Brighton	South Platte and Beebe Draw Well	3,200	
Metro	South Metro Water Supply Authority, Denver Water, Aurora	WISE	7225	2021
South Platte	Erie	Erie Reclaimed Water	5390	
		TOTAL:	58,135	

Regional cooperation on reuse projects, like the Water Infrastructure and Supply Efficiency (WISE) project in the Metro area, can help further stretch locally available supplies. WISE agreements have been executed and deliveries will begin in 2016 and reach a full delivery of 10,000 acre feet/year (on average) by 2021. The project uses available reusable supplies from Aurora Water and Denver Water, diverted and delivered through Aurora's Prairie Waters collection and treatment system. Nevertheless, some municipal supplies, including the Colorado-Big Thompson Project, are single use water supplies and cannot be reused by municipal water users.

The South Platte/Metro Basin raised some concerns about the limitations of reuse and how reuse affects downstream users. Some of the technical limits of reuse were infrastructure capacities, losses, supply and demand timing, water quality, treatment costs and brine disposal, and regulatory requirements.¹⁸⁷ The South Platte/Metro BIP does however advocate that the state should "direct the Colorado Water Quality Control Commission to look for ways to assist and facilitate reuse."¹⁸⁸

Southwest Basin

The Southwest Basin has a goal to "Support and implement water reuse strategies" using an educational strategy. The basin proposes to implement at least three different informational events around reuse efforts during which they will highlight tasks, tools, and strategies.¹⁸⁹

^d The yield of PWP expansion depends on the yield of other projects such as the Eagle River Project, Box Creek and Growth into existing supply, in addition to the future demand scenario used to calculate Aurora's remaining gap.

Yampa/White/Green Basin

The Yampa/White/Green Basin considers reuse principally as a pre-condition for trans-mountain diversions, and not necessarily as a strategy for the basin to undertake firsthand.

The basin states that “Prior to undertaking development of a new trans-mountain diversion, the Front Range must first integrate all other water supply solutions including conservation, reuse, and maximize use of its own native water resources and existing trans-mountain supplies.”¹⁹⁰

Actions

1. **Explore regional reuse options:** Over the course of the next three years, the CWCB will conduct a technical review of regional reuse options and provide grants to support regional reuse plans and projects.
2. **Improve quantification, planning and tracking for potential reuse projects:** Over the next two years, the CWCB will conduct more research on how much water is currently being reused, how much potential there is for reuse, and how much water providers plan to reuse. As a future planning effort, regional reuse plans and projects should be explored to use economies of scale. As part of this work, the CWCB will work with partners to map all wastewater and potable infrastructure, water rights, needs, cost, and benefits to assess feasibility of potable reuse projects in Colorado. In addition, potential impacts to return flows will be examined.
3. **Clarify the regulatory environment:** Over the next two years, the CWCB and the CDPHE will work with stakeholders to examine the application of water quality regulations to reuse water to identify potential change that fosters permanent growth in the reuse of limited water supplies and that protects public health and the environment.
4. **Provide financial incentives for reuse innovation:** As recommended in the DPR white paper, over the next year, the CWCB will proactively seek applicants to use WSRA grant funds for expanded research and innovation related to the technical challenges and solutions of reuse. This includes exploring areas such as ZLD, IPR, and DPR, examining regional opportunities, increasing the reliability of the technology, on site reuse of water, development of reuse water for food crop irrigation, and the ability to share reuse water. Such research also includes support for continued development of more cost-effective and environmentally acceptable RO concentrate management techniques and the evaluation of non-RO based treatments capable of producing water suitable for DPR.¹⁹¹
5. **Encourage the Examining Board of Plumbers to adopt the International Plumbing Code to allow for graywater.** The CWCB will encourage the Colorado Plumbing Board to adopt and incorporate the appropriate graywater provisions from the chapter or appendix of the International Plumbing Code to allow for graywater piping within structures.
6. **Expand loan programs:** The CWCB will explore expanding its loan program to include loans for innovative or regional reuse projects. The DNR will work with the General Assembly to institute this modification during the 2016 legislative session.
7. **Support reuse education:** As recommended in the DPR white paper, the CWCB will support stronger education to describe the benefits of reuse water as an integral part of a water supply system for the potential of reuse to be fully realized. Specific recommendations are to sponsor a survey of Colorado utilities and water agencies to

determine the extent to which DPR may be considered as a means to augment their legally reusable water supply portfolios and to develop a program to educate the public, elected officials and water utilities about the benefits and safety of DPR.¹⁹² More detail regarding specific education and outreach recommendations are detailed in Section 9.5.

8. **Examine mechanisms to improve the ability to market, sell, and share reusable supplies:** Through a stakeholder process, the CWCB will investigate mechanisms to better allow for reuse water to be marketed to water providers outside a service area and could make building a reuse project more desirable.

6.3.3 Land Use

As Colorado grows, land-use planning and water planning will become more closely connected through integration of principles from both disciplines. Integration does not mean the dilution of local control. Private property rights, 1041 powers, and local zoning and development control will not be diminished by connecting these planning disciplines. The potential exists for financial incentives, best practices, partnerships, and technical resources to better coordinate and enhance both land-use and water planning.

The manner by which Colorado develops into the future will have a strong influence on Colorado's future water supply gap and vice versa. This topic is relevant today as illustrated by the fact that six boards of county commissioners (from eastern and western slopes), including Boulder, the city and county of Denver, Eagle, Grand , Pitkin, Summit, as well as elected officials from the city and county of Broomfield collaborated to craft comments for Colorado's Water Plan on land-use-water integration. The importance of water-sensitive land-use planning was stated as, "1. Decrease the water supply Gap. As Colorado's population continues to grow, well thought out, effective, sustainable, and predictable land-use planning is essential. 2. Provide low cost alternatives for meeting the Gap. Water sensitive land-use often results in less stress on water systems, indoor and outdoor water savings, and reduction in expensive long-term capital outlay. 3. Protect the values of Colorado, including vibrant economies, agriculture, open space, and recreation. Local land-use planning should be among the first points of consideration to protect and support all of Colorado's values and economic drivers. 4. Create more predictability and reliability as well as reduce risk in water supply planning, in turn creating more sustainability for current and future residents. 5. Encourage shared solutions including best management practices, collaborative physical projects and practical land-use models to address water quality and quantity challenges. 6. Result in benefits that reduce infrastructure and service costs, and enhance a community's quality of life".¹⁹³

The CWCB began preliminary work in this arena in 2009 by hosting the *Water and Land Use Planning for a Sustainable Future* conference and in 2010 by creating an associated report and density memo describing several actions that bridge land and water issues.¹⁹⁵ Recently, urban land use has been a major discussion point at the IBCC, which incorporated several options into the Water Conservation No and Low Regrets Action Plan. Additionally, at the July 24, 2013 Joint Front Range Roundtable meeting, 92 percent of the participants strongly agreed or agreed to the recommendation that water supply planning and land-use planning should be coordinated. At that same meeting, 55 percent of the participants agreed that “coordination of urban land planning and water supply planning” was the most important conservation recommendation to discuss that day.¹⁹⁶

“Every community can do better on water conservation and efficiency via locally determined measures such as but not limited to reinvestment in aging infrastructure, community education, enhanced building codes and water sensitive land-use planning”

Guiding statement for County Commissioners¹⁹⁴

The following projects and initiatives illustrate these recommendations and are occurring today in Colorado.

Net Zero Water

The Colorado Water Innovation Cluster is researching Net Zero Water through a CWCB Water Efficiency Grant and has assembled a large stakeholder group to create a Net Zero Water planning template, guidebook and toolkit.¹⁹⁷ Net Zero Water is a water management concept that mitigates the water quantity and quality impacts through best practices incorporated into the development or management of a site. Net Zero Water can be applied to a building site or a more regional scale and connects water management to land-use planning. The Net Zero Water Planning Template, including the guidebook and toolkit, will help users quantify their water footprint, evaluate reduction strategies, and recognize financial and environmental benefits from reducing their water use and water quality impacts.¹⁹⁸

Land Use Leadership Alliance

A recent collaborative effort involving water planners and land-use planners from local jurisdictions is moving the dialogue forward. Pace University School of Law’s Land Use Law Center brought their Land Use Leadership Alliance training program to Colorado in the fall of 2013. This training convened land-use and water planners along with city managers, city council members, developers, regional government planning groups, and CWCB staff for four all-day sessions focused on the land-use and water planning nexus. These sessions proved very productive for developing strategies for better integration of land and water planning, and also assisting in the development of relationships between land and water planners within and between municipalities.¹⁹⁹ This collaboration is a model for integrating local planning efforts within a local government and into regional planning efforts. The latest LULA trainings took place in May 2015, with the training of five more Front Range municipalities, including Westminster, Lakewood, Commerce City, Broomfield, and Aurora. Additionally, representatives from South Adams Water and Sanitation, Denver Water, Bancroft-Clover Water, and Green Mountain Water and Sanitation attended. The LULA trainings

will serve as a template for the trainings that the CWCB and the DOLA will carry out in 2016 as outlined in SB15-008.

Denver Regional Council of Governments MetroVision (DRCOG)

The DRCOG has also been exploring the nexus between water use and land-use patterns in recent years. Adopted in 2011, the latest *Metro Vision 2035* document for the first time includes a section that ties water conservation to land-use planning.

Denver Regional Council of Governments has a goal of increasing housing density by 10 percent between 2000 and 2035.²⁰⁰ According to Denver Regional Council of Governments' most recent analysis, the region has increased density by 5.3 percent since 2000. This data suggests that the region is well ahead of reaching the 10 percent projected goal by 2035.²⁰¹ This 10 percent increase will produce approximately a 5 percent decrease in water use in the residential housing sector. The 5 percent equates to 31,000 to 46,000 acre-feet of annual savings for the Denver metro area depending on population growth. This includes existing population and new population. At the medium population growth, this is nearly 42,000 acre-feet of savings annually.²⁰²

Colorado Water and Growth Dialogue

The CWCB is funding a project to estimate the demand reductions from various land-use patterns with a WEGP grant that addresses the water and growth dilemma. The Keystone Center secured funding from several grantors (including the CWCB) to complete a two-year dialogue that will bring together water providers, land-use planners and developers, public officials, and other key stakeholders. The goal is to identify meaningful strategies, practices, and policies that will help Coloradans achieve a measurable reduction in the water footprint of new development and redevelopment and move closer to a long-term balance between water use and growth. To date, the project has produced a draft research report that examined strategies for implementing land-use patterns that reduce water demand. Four strategies were identified as having the most potential to reduce water demand: Smaller residential lots (cluster development), changing from Single Family to Multi-Family development (infill), increasing Multi-Family (moving -up) and turf/irrigation restrictions.²⁰³ Additionally, Denver Water and Aurora Water are modeling water use patterns from their service areas on top of existing land-use patterns. The group will then use DRCOG's UrbanSim model to generate future land-use patterns

Denver Regional Council of Governments Water Conservation Vision, Goal, and Policies

Vision: The Denver metro region will maximize the wise use of limited water resources through efficient land development and other strategies, recognizing that no single strategy will meet the state's water needs and the region will need to pursue a range of strategies concurrently.

Goal: Reduce regional per capita M&I water use by working with municipalities, counties, water providers, and other stakeholders within the next 6 to 12 months (February 2012) to identify a specific numeric target or measurable benchmark against which to measure progress.

Policies:

1. **Regional Collaboration.** DRCOG will bring together local governments, water providers and other stakeholders to facilitate collaborative efforts to promote water conservation.
2. **Best Practices.** DRCOG will work to increase understanding of the link between land development and water demand, and to identify best practices for promoting the efficient use of water resources across the region.
3. **Efficient Land Development.** Compact development, infill and redevelopment consistent with DRCOG's urban growth boundary/area and urban centers policies will help reduce water demand and related infrastructure costs.

Source: DRCOG *MetroVision 2035*:34

with the overlay of water use patterns. As the project progresses, several different exploratory scenarios will be generated out to 2040 that could include effects of climate change, economics, market demand and political will for regulation. This water and growth project will create a report and roadmap in 2016 that describes the most promising strategies for addressing the water and growth dilemma in Colorado, along with specific recommendations for implementing and disseminating the strategies²⁰⁴

Recent legislation

In 2008, legislation passed requiring that building permit applications for developments of more than 50 single-family equivalents include specific evidence of an adequate water supply, defined as one sufficient for the development through build-out in terms of quality, quantity, and dependability. The developers must submit proof of adequate supply to the local government through a report from a professional engineer or water supply expert that identifies the water source and the types of demand management appropriate for the site. Under this law, a local government was permitted to make the adequacy determination only once at the beginning of the development permit approval process.²⁰⁵ In 2013, the governor signed legislation that modified the definition of the term "development permit" to clarify permits may be granted for individual stages in the development permit approval process, rather than for the entire development.²⁰⁶

In 2015, SB15-008 passed, which tasks the CWCB and the DOLA to carry out trainings for local water use, water demand, and land-use planners. The topic areas will cover best management practices for water demand management, water efficiency and water conservation. Additionally, the bill requires that best management practices for water demand management, water efficiency, and water conservation that may be implemented through land-use planning efforts must be evaluated in all covered entities' water efficiency plans.

BIPs

Each basin roundtable is formulating their own implementation plan that will include land-use goals and activities in addition to already planned projects and methods that are explored throughout Chapter 6.

Arkansas Basin

The Arkansas Basin did not address land use in an extensive manner in the BIP. The Arkansas Basin did, however, create a policy calling for the integration of land-use and water-resource planning.

The Arkansas Basin came to consensus on a policy statement regarding land-use and water-resource planning.

- Policy Statement: The Arkansas Basin Roundtable supports the integration of land-use and water-resource planning.²⁰⁷

Creating a policy statement for this type of integration is an important first step in the future of demand management in the Arkansas Basin.

Colorado Basin

The Colorado BIP created a theme and set a goal, measurable outcomes, and short- and long-term needs, and projects and methods related to land use and that connect to water conservation.

Theme 5 is “Develop local water conscious land use strategies” and the main goal is to “develop land-use policies requiring and promoting conservation.” The measurable outcomes associated with this goal include:

- Developing recommendations for city, county, and state governing bodies promoting water awareness and efficiency in land-use policy.
- Developing educational material or opportunities for elected and planning officials on water supply issues and conservation options.
- Preserving agriculture by reducing the transfer of agriculture water to municipal use.²⁰⁸

The Colorado Basin also set out short term needs, long term needs, and projects and methods to accomplish this goal. In the short term, they will review existing land-use regulations for water conscious development requirements and evaluate potential growth in unincorporated areas and water supplies to those areas. In the long term, they will provide financial support to local jurisdictions to implement water conscious development requirements and draft recommended model basin and statewide land-use planning guidelines that focus on water conservation and water efficient land-use development. As for projects and methods to accomplish the goal, the Colorado Basin suggests that statewide grant opportunities should be created for local jurisdictions to review land-use regulations, conduct public outreach, and implement regulations. Additionally, current governmental council should develop model land-use regulations and every county and city within the basin should have conservation plans with identified goals. Additionally, the plan also asks that the state land-use regulations be evaluated to meet long term exponential state population growth (and water demand) with a limited water supply.²⁰⁹

Additionally, the Grand County Region, Summit Region, Eagle River Region, Middle Colorado Region and the Roaring Fork Region all developed specific land-use themes and methods in their needs analysis.

The themes include:

- Develop local water conscious land-use strategies that focus on growth that affects water supplies and nonconsumptive/environmental needs.

The methods include:

- Limit development to within urban boundaries
- Promote water conscious growth development through improved land-use policies.
- Water providers should work with neighboring entities to provide and plan for growth between boundaries
- Implement water provider conservation projects
- Review local governments’ land-use policies for water-quality and environmental protection standards.
- Assess county master plans and codes for improvements in smart growth land-use policies
- Ensure new development appropriately incorporates water-related values²¹⁰

Gunnison Basin

As with other BIPs, the Gunnison BIP ties land use to water conservation and demand management. The Gunnison BIP set out goals related to land use and water conservation. Goal 9, which deals with public outreach and education around the role of citizens of the Gunnison Basin, identifies land use as a process to achieve this goal: “The GBRT Education Committee will prepare and present annual half-day State of the River seminars for local governments and planning staffs, with the objective of making sure that land-use decisions and new developments are made within the context of the Basin’s probable water future”²¹¹

The Gunnison Basin also identified statewide principles where water efficiency, conservation and demand management were intertwined throughout several of them.

Principle 5: *Water conservation, demand management, and land-use planning that incorporates water supply factors should be equitably employed statewide*–“Demand management strategies supported by the Gunnison Basin include growth only in proximity to existing or planned infrastructure, high density versus urban sprawl, and landscape limitations. Development in proximity to existing infrastructure should be encouraged only in non-productive, or the least productive, land to preserve productive agricultural land. The Gunnison Basin believes that land-use policies are essential to promoting both water and land conservation. Local land-use policies and regulations should discourage sprawl, link water supplies to development, and provide incentives for higher density developments.”²¹²

Additionally, the Gunnison Basin discusses land use in terms of Colorado River supplies. Under Principle 3: *Any new supply project from the Colorado River System must have specifically identified sponsor and beneficiaries and meet certain minimum criteria*, “entities must incorporate water supply factors into land-use planning and development”²¹³

North Platte Basin

Because of low population and little municipal use, the North Platte Basin did not address land use in their plan.

Rio Grande Basin

As stated previously in this chapter, the Rio Grande Basin has a low population and relatively minor municipal water use. The Rio Grande Basin does not address land use the same way the more urban water basins have but instead describes the use of conservation easements to manage land development. The conservation easements preserve agricultural land as well as environmental attributes.²¹⁴

South Platte/Metro Basin

According to the South Platte/Metro Basin, municipal water departments are tasked with meeting a large portion of the water supply needs in the South Platte Basin and are already using programs such as water audits, rebates for efficient water fixtures and appliances, and education to reduce demand. These efforts could be more effective if water departments worked with their respective planning departments to plan and require water efficient usage and land development within their

city. For instance a water department can work with its planning department to implement water efficient landscaping codes, subdivision regulations, zoning requirements, and master plans.²¹⁵

Nevertheless, the current roles of many water utilities are generally limited to providing for water needs within their service areas and do not cross over to land-use authority. The South Platte/Metro Basin discusses the current situation of land-use authority and water provider authority, opportunities for collaboration, and examples of current work in this arena. The plan describes the issue that has made collaboration between water and land-use planning difficult in the past. The South Platte/Metro Basin states that, “The primary responsibility held by water utilities is to provide for water needs within communities. Coordinating or integrating the land-use and water-planning process is a relatively new area being explored for reducing municipal water use. Increasing awareness of limited future water supply opportunities and the potential impacts of climate change helps to spur this integration of planning.”²¹⁶

The South Platte/Metro Basin states that there are opportunities that exist today for closer collaboration and reduction in water use through more integrated land-use planning. These include:

- Updates to Comprehensive Plans,
- Changes to zoning requirements,
- Revising water/land-use subdivision regulations, and
- Using the direction provided by the State Water Engineer and recent legislation.²¹⁷

As part of the opportunities the plan states that “Increasing residential density has the potential to significantly improve water use efficiency and will continue to result in reduced impacts on natural resources. The highly urbanized areas of the Front Range corridor have many opportunities to redevelop lands for higher population densities.”²¹⁸

A few of the projects highlighted by the South Platte/Metro Basin are the Keystone Center Land Use Study and the Land Use Leadership Alliance Training program (LULA). The Keystone Center project will identify land-use patterns across the metro area and find ways to integrate land and water planning more closely. The LULA training program “focuses on finding land-use solutions to the challenges posed by growing Front Range populations and Colorado’s limited water resources. The LULA program is designed to help local land-use and water leaders create new networks of support, identify successful land-use techniques, and develop implementable local strategies that will enable a more ‘water-smart’ future for the region.”²¹⁹

The South Platte/Metro BIP ends with a land-use recommendation in the section *Recommendation for Additional SP-BIP Analysis and Refinements* to be:

Further Analysis of Planning Coordination— The South Platte and Metro Roundtables recommend further investigation into options for increased coordination between water utilities and land-use planners to better plan for water-efficient growth.²²⁰

Southwest Basin

Implement informational events about water conservation, land-use planning and water reuse efforts, tools and strategies. “One strategy to achieve the short-term goals of conservation, land-use

planning (which will include coverage and discussion of the 60/40 and 70/30 ratios referenced above), and water reuse is to implement a pilot conservation and land-use planning session in 2015. Initially it is anticipated that this would be a two to four hour workshop for local decision makers and water utility personnel.” If successful, the session could move throughout the basin (e.g. Cortez, Telluride, Pagosa Springs, etc.) similar to the Water 101 Seminar.²²¹

Yampa/White/Green Basin

The Yampa/White/Green Basin did not describe projects or plans for land use in their BIP. .

Actions

To facilitate the use of local land-use tools to reduce water demands for municipalities and urbanization of agricultural lands, the following actions are needed.

1. **Encourage the use of local development tools:** Through trainings established by Colorado’s General Assembly, the CWCBC in consultation with the DOLA, will work with numerous partners to encourage local governments to incorporate best management practices for water demand management, water efficiency, and water conservation that may be implemented through land-use planning efforts. These trainings will begin in 2016. These include:
 - Expediting permitting for buildings and developments with high levels of density that incorporate certain water efficiency measures, such as efficient irrigation systems (with plan check and install check);
 - Inclusion of water supply and demand management in comprehensive plans
 - Installing climate appropriate plants;
 - Using appropriate amounts of soil amendments;
 - Incentivizing maximum irrigable area or WaterSense certified landscapes;
 - Instituting tax incentives for developments that incorporate certain water efficiency measures or high levels density such as cluster developments;
 - Establishing structured impact (tap) fees designed to promote water-wise developments and in-fill; and
 - Developing water budget rate structures to help maintain initial projected water budgets for a site
 - Introducing landscape and irrigation ordinances
 - Creating more stringent green construction codes that include higher efficiency fixtures and appliances and more waterwise landscapes
 - Exploring landscape professional education or certification programs
 - Examining opportunities to reduce agricultural urbanization and fragmentation.
2. **Examine barriers in state law for implementing the above local development tools:** Over the next 18 months, examine barriers to local development tools that local jurisdictions may face while implementing the tools.

3. **Incorporation of Land-use Practices into Water Conservation Plans:** Over the next eighteen months, the CWCB will develop new guidance for water conservation plans to require the incorporation of land-use practices. This is an addition to C.R.S. 37-60-126.
4. **Strengthen partnerships:** To be successful in integrating land-use and water planning, the CWCB will need to partner with many different agencies and groups. The CWCB will set up meetings with the various agencies within the next year to map out how the CWCB and other agencies can work together on these issues.
 - Local municipalities/local water providers/county governments - These entities will carry out water and land-use plans. Without their partnership and support of new ideas, comprehensive water and land planning will not succeed.
 - The DOLA is involved in the land-use and local government arena. Like the CWCB, the DOLA also has grant funding that could be leveraged for water and land-use planning initiatives, such as incentives for incorporating water supply into comprehensive land-use planning.
 - The DORA regulates professionals in various industries and works to create a fair marketplace. The CWCB will work with the DORA to focus on the landscape and irrigation industry or the property management industry and to consider developing certifications for these industries to conserve water.
 - Home Building/Construction (Home Builders Association, LEED, U.S. Greenbuilding Council). This industry will be building communities that will have a direct impact on water demand so must be involved in crafting the vision for future water sensitive developments.
 - Non-Governmental (Keystone Center, Alliance for Water Efficiency, Western Resources Advocates, American Planning Association, economic development councils). These institutions can further land-use and water integration innovation and research.
 - Academia (Colorado State University, University of Colorado Boulder, University of Colorado Denver, One World One Water Center-Metropolitan State, Rocky Mountain Land Use Institute). These academic institutions can further land-use and water-integration innovation and research.
 - Land Use Leadership Alliance- This organization brings an innovative training model that could change the way Colorado looks at this subject by breaking down institutional silos. The CWCB will work with LULA, or another local group, on creating a Colorado-specific training model for sustainable long term land-water planning integration.
 - Councils of Governments- These entities make the connection between local and state level. Council of Governments can be strong allies in trainings and research into the land-water nexus.
5. **Funding:** The CWCB should use Water Efficiency Grant Program (WEGP) funds and Water Supply Reserve Account grant funds to fund aspects of the land-use and water planning nexus. The CWCB will work with the basin roundtables to proactively seek applicants to use WSRA funds for larger regional efforts tied more directly into the basin roundtables, while the WEGP funds will be used for smaller more localized efforts.

6.3.4 Agricultural Conservation, Efficiency, and Reuse

Introduction

This section seeks to assist Colorado's agricultural industry to be more efficient and resilient and to reduce non-beneficial water consumption without impacting statewide agricultural productivity and the environment. Opportunities to stretch water supplies to help meet future needs are explored. The discussion of agricultural water use often gets confounded by imprecise use of terms and an incomplete understanding of agricultural water systems. This section presents a basis for an analysis using a common understanding of terms.

Background on Agricultural Water Use and Losses

Where rainfall is insufficient to meet crop needs, crop irrigation is needed. The process of irrigation and the associated consumptive use (CU) and losses of water is illustrated in Figure 6.3.4-1. In some cases, a deep rooted crop may withdraw water directly from shallow groundwater areas through a natural process known as subirrigation.

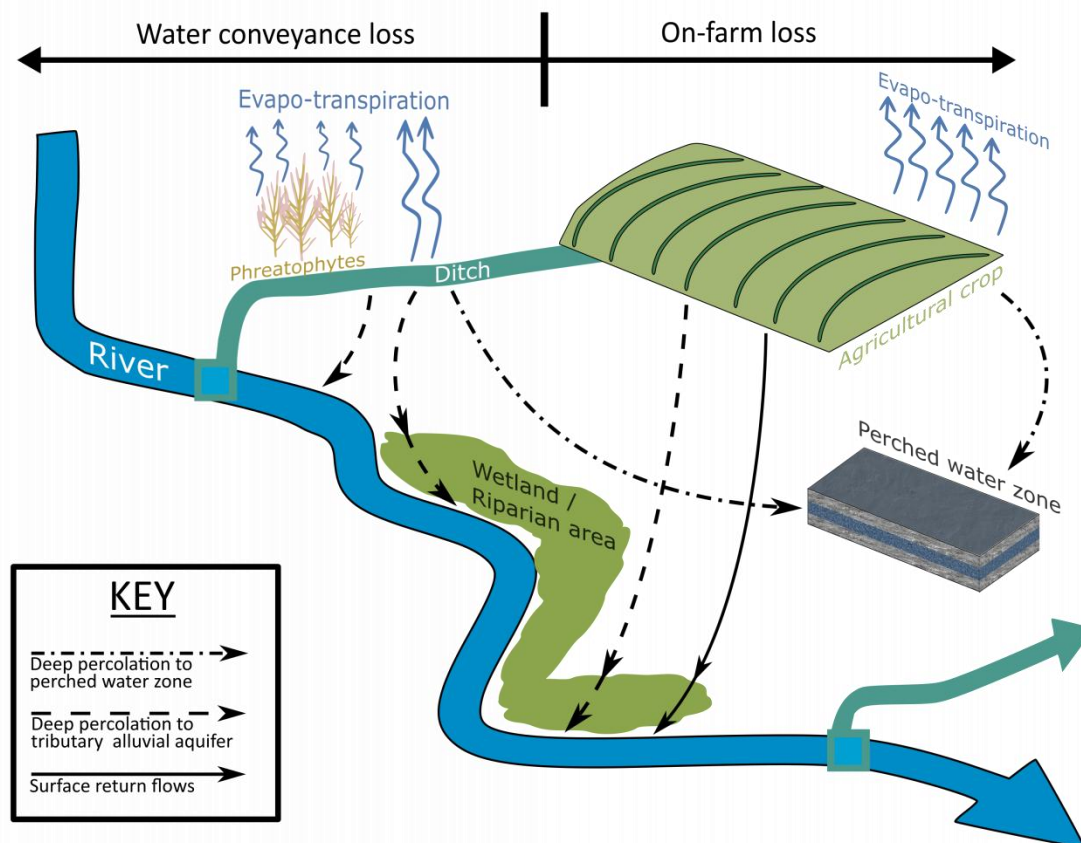
During the process of irrigation, water conveyance loss occurs when some of the water diverted via ditch or canal never reaches the crop. These losses can occur due to ditch or canal seepage where the water either returns to the stream via seepage into the local groundwater system through deep percolation, or via non-beneficial consumptive use by phreatophytes.²²² Ditch or canal seepage is considered nonconsumptive because the water returns as surface flows in the river system and is available for other users. Some conveyance loss is permanent, in which case it is frequently referred to as non-beneficial consumptive use. For example, this loss can include evaporation from exposed water or soil surfaces of ditches and canals and the unintentional growth of phreatophyte vegetation with no agricultural value. Colorado State University estimates that as much as 10 percent of the water lost during irrigation is a result these types of non-beneficial consumptive use.²²³ Nevertheless, some of these unintended uses provide environmental benefits by creating wetlands and enhancing riparian corridors.

Once the water reaches the field, it is either used by the plant as a CU or it becomes part of on-farm losses. Irrigation provides water to the crop's root zone to meet crop CU, which occurs through transpiration from the growing plants and evaporation from adjacent soil surfaces. The combined effect of transpiration and evaporation is called evapotranspiration (ET). Plants transpire water during photosynthesis and also incorporate a small portion of the water into the plant tissue. Water consumed by ET is permanently removed from the local hydrologic system.²²⁴ Because ET is equivalent to the entirety of the water used by a plant, the beneficial use of an irrigation water right is therefore measured by the amount of crop ET. Crop ET is not easily measured. Rather, theoretical or potential ET (the maximum amount of water a crop can consume) is calculated based on the factors that influence ET, such as crop type, growing season, and daily climatic conditions. Crop ET is measured at a specific location by adjusting for the amount of water applied to the crop.²²⁵

On-farm losses occur when water is applied to fields at a rate that exceeds the ability of the soil to retain the water resulting in deep percolation or surface runoff. Deep percolation into underlying groundwater systems raises the local groundwater table, thereby returning water to the surface

system through stream accretions.²²⁶ In locations where the amount of deep percolation exceeds the ability of an aquifer to quickly transmit water back to the stream, groundwater storage occurs and produces lagged return flows. In some cases deep percolation collects in perched zones not connected to the regional groundwater system and is permanently lost to the river system as a type of non-beneficial CU. Surface runoff, on the other hand, occurs when the rate at which water is applied to a field exceeds the rate at which water infiltrates into a given soil type. Surface runoff is returned to the surface water system via waste ditches and drainage works.

Figure 6.3.4-1 Agricultural Water Use and Losses



Collectively, the majority of water diverted but not consumed creates return flows to the stream.²²⁷ Return flows are a critical component of the agricultural water balance and are rigorously protected under Colorado water law for the benefit of other users on the system.²²⁸ Diversion of water in the stream as a result of return flows is a fundamental element of the water supply in Colorado. A portion of each subsequent diversion provides new return flows for users further downstream allowing multiple diversions of the same water within a basin.²²⁹ In over-appropriated basins an individual molecule of water will be diverted several times before it leaves the State or is finally consumed.²³⁰

Terminology Related to Irrigation Efficiency

There are several terms and phrases frequently raised in discussions related to irrigation efficiency. The following definitions, in conjunction with Table 6.3.4-2, are used to provide clarity to this complex topic.

- Irrigation Efficiency:**

Irrigation efficiency is the ratio of the total amount of water diverted for an irrigation use to the volume of water beneficially consumed through ET by the crop. Irrigation efficiency may be further refined by looking at the specific water losses that occur before and after the water is applied to the crop. Thus there are often separate calculations of delivery efficiencies and on-farm efficiencies. Since it is a ratio, irrigation efficiency may be increased by practices that either reduce the amount of water consumed or diverted but not consumed. Because of this, “irrigation efficiency” is used as a general term to refer to agricultural conservation and efficiency practices on the farm and associated with conveyance.

- Water Conveyance (Delivery) Efficiency:**

Delivery efficiency reflects seepage, evaporation, and ET losses that occur in the canals, ditches, and laterals between the point of diversion and the turnout to the farm field.²³¹

- On-farm Efficiency:** On-farm or application efficiency reflects the losses that occur after the farm turnout as water is applied to a crop, including deep percolation, evaporation, and field runoff.²³² Application methods such as flood and furrow have higher losses than more direct methods (such as sprinklers and drip).²³³

- Agricultural Water Conservation:** Agricultural water conservation is the water resulting from on-farm practices that reduce the amount of irrigation water beneficially consumed during the production of an agricultural commodity. The amount of such water can be measured as a reduction in historical consumptive use.²³⁴ Examples of non-structural agricultural water conservation practices include changes in crop type, reduction of crop area, deficit irrigation,

Figure 6.3.4-2 Irrigation Efficiency Outcomes

	ON FARM	CONVEYANCE
CONSUMED WATER	Agricultural Conservation <ul style="list-style-type: none"> The reduction of irrigation water beneficially consumed during the production of an agricultural commodity. Beneficially consumed, therefore marketable. <div> Examples <ul style="list-style-type: none"> Changes of crop type or reduction of crop area Deficit irrigation Soil health improvements Drip irrigation and mulching </div>	Salvaged Water <ul style="list-style-type: none"> Reductions in non-beneficial consumptive losses incidental to the use of irrigation water. Not beneficially consumed, therefore not marketable. <div> Examples <ul style="list-style-type: none"> Removal of phreatophytes Ditch lining or piping </div>
UNCONSUMED WATER	Saved Water <ul style="list-style-type: none"> Produced by the intentional reduction of historical water diversions not previously consumed during conveyance or on the field. Voluntary flow agreements can be used to shepherd this water for environmental or recreational use. <div> Examples <ul style="list-style-type: none"> Diversion dam and headgate improvements Ditch lining Sprinkler instead of flood irrigation </div>	

and soil-health improvements that reduce evaporative loss. Because agricultural water conservation is a reduction in historical consumptive use, it is the only irrigation-efficiency practice that can be marketed to other beneficial uses. However, there may be challenges associated with administering these water-rights transfers.

- **Salvaged Water:** Salvaged water is water lost from the consumptive use or permanent loss of water that does not provide a beneficial use. These losses are incidental to the use of irrigation water. For example, this can be ET from phreatophytes or deep percolation to a perched zone. In all cases the water is lost or consumed, although not beneficially. Salvaged water can be produced through efficiency improvements that eliminate losses that were previously consumed.²³⁵ For example, removal of invasive phreatophytes and ditch lining or piping water could yield salvaged water.
- **Saved Water:** Saved water is produced by intentionally reducing the unconsumed portion of water diversions that otherwise provided a portion of historical return flows. Such saved water can come from either on-farm or conveyance efficiency practices that reduce losses that were not previously consumed.²³⁶ Such water can be left in the stream, but it may not provide a benefit to environmental or recreational values without a voluntary flow agreement. Headgate improvements, ditch lining or piping, and other efficiency improvements can produce saved water.
- **Reuse:** Capturing and reusing irrigation water for crop use on the same ground, when consistent with the underlying water right, is frequently done. Because this water is also consumed it does not result in agricultural water conservation, although it may reduce the total amount of water diverted. Reuse when not consistent with the terms of a water right (such as reuse on acres not described in a decree) is considered an “expanded use,” which is prohibited.²³⁷

On the other hand, reuse of treated M&I water for an agricultural purpose may have the potential to reduce irrigation diversions by allowing that M&I reuse water to be used as an additional source of agricultural supply. Reuse is more fully explored in Section 6.3.2.

- **Waste:** Waste is a term that is often used pejoratively to refer to water diverted but not beneficially consumed.²³⁸ It is frequently used in expressions such as, “by eliminating agricultural waste we can meet future needs” or “one man’s waste is another man’s water supply.” “Beneficial use” is legally defined to be the amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made.²³⁹ The state engineer has authority to curtail truly wasteful practices and there is little waste occurring in agricultural water use. Some elements of water use that might otherwise be considered waste are important to agricultural production. For instance, water is occasionally diverted into ditches and immediately returned to the stream to sluice sediments from diversion and conveyance works. Another example is when excess water is applied to fields to leach harmful salts from the crop root zone through intentional deep percolation into the underlying water table. In areas with limited water storage availability and highly variable surface flows, some irrigators divert more water than can be used at that time by a crop in an effort to store the excess water in the soil profile. While it is a highly inefficient method of storage, for many irrigators it is the only option to mitigate

future supply shortages. This practice is not considered wasteful or unreasonable under the circumstances.

- **“Use it or lose it”:** The common usage of the phrase is associated with the incorrect belief that by maximizing the amount of water diverted the magnitude of a water right can be enhanced or preserved. This notion is incorrect since the true measure of the water right is actual historical beneficial CU, which in the case of an irrigation right is crop ET.²⁴⁰ Thus there is no real incentive under law to divert more irrigation water than the crop will eventually consume. In addition, a water right can be abandoned or lost due to non-use for a long period of time, but only if the non-use is indicative of an actual intent to give up the water right permanently.²⁴¹ One aspect of the “use it or lose it” perception does bear further consideration. Under current law the determination of historical consumptive use is based on the amount of water actually consumed by the crop, which is the lesser amount of the water actually applied to the crop or the maximum amount a given crop could potentially consume. Thus, engaging in deficit irrigation for a period of time could reduce the transferable yield in a future change of water right case, which is a disincentive to adopting these new practices. The legislature provided partial relief to this problem in Western Colorado, via CRS 37-92-305(c), which allows for CU reductions without affecting historical CU calculations if the water user is under a conservation plan.

Benefits of Irrigation Efficiency

Irrigation efficiency can increase crop production, and enhance flows for environmental and recreational needs, and increase opportunities for water marketing through water sharing practices. Water-sharing practices are discussed briefly in this section and in further detail in Section 6.4.

Increased crop production: A large segment of agriculture in Colorado operates with a water deficit,²⁴² meaning that the available supply at some periods during the growing season is less than the amount needed to fully satisfy crop irrigation water requirements, (consumptive needs) at that time. Thus, the primary incentive for a producer making efficiency improvements is to satisfy a crop’s water consumption by eliminating conveyance and on-farm losses, to increase crop yields. The intention of this practice is to increase crop production through increased consumptive use, and it does not create new water supplies available for other users.

Enhanced flows for the environment & recreation: Refurbishing a headgate, diversion dam, or reducing diversions can increase flows below the water structure, potentially benefiting recreation and the environment. Even though this water cannot be transferred, local instream-flow benefits accrue from saved water left in the reach of the stream between the historic point of diversion and the downstream headgate. This is limited to the location where return flows previously entered the stream. Environmental benefits of refurbished agricultural infrastructure present an opportunity for funding from state, federal, and foundation programs to contribute to the cost of efficiency changes. Environmental and recreational benefits can be enhanced and protected through a voluntary flow management program or agreement negotiated with downstream water users.

Improved water quality: One benefit from improved irrigation efficiency is improved water quality. The process of deep percolation results from delivering more water into the root zone than the soil can retain for eventual crop consumption. This water migrates into the groundwater system, often dissolving natural salts, uranium, and selenium and leaches manmade fertilizers and pesticides from the soil. These contaminant loads eventually reach the stream system, and in some cases seriously degrade surface water quality.²⁴³ Recognition of water-quality benefits results in substantial amounts of federal funding for irrigation-efficiency improvements, which over the past several decades has rapidly accelerated the historically slow trend toward improved irrigation efficiency.

Water sharing: While there are numerous reasons and methods to improve irrigation efficiency, there are limited opportunities for true agricultural water conservation for the purpose of creating supplies that can be marketed to other users. These methods rely on either reducing crop ET or soil moisture evaporation. They can be achieved by:

- Switching crop types to those with lower ET requirements.²⁴⁴ The variation in ET needs between crops can be large, with beans and small grains requiring 20 inches or less per year and corn, beets, and alfalfa needing 30 or more inches.
- Intentionally supplying less water to a given crop than its historical irrigation requirement through deficit irrigation. Deficit irrigation must result in lower crop yields to generate any salvaged water.²⁴⁵
- Reducing soil evaporative losses through improved cultivation methods such as mulching, drip irrigation, and “soil health” practices.²⁴⁶
- Temporarily and entirely removing a crop from the ground through fallowing.²⁴⁷
- Permanently and entirely removing a crop from the ground through land retirement.²⁴⁸

Addressing Barriers to Irrigation Efficiency

While these techniques have been used in Colorado to address specific situations, there are legal, technical, and financial barriers that often prevent long-term new water supplies. Section 6.4 discusses how some of these techniques can be used as alternatives to traditional permanent dry up of irrigated lands.

The transfer of salvaged water (with the exception of phreatophyte removal, which has been expressly prohibited as a source of a transferable right) has not yet been tested in water court or addressed by the legislature. The volume of water resulting from any individual efficiency improvement is relatively small and difficult to precisely quantify since it cannot be measured directly. This makes reliable management and administration of exchanges and transfers of salvaged water extremely complex and time consuming for DWR personnel. Saved water cannot easily be used to reliably provide water to the environment or recreation. There is little direct advantage for irrigators and few legal mechanisms exist to shepherd this water downstream. Water generated from agricultural conservation practices, such as deficit irrigation, rotational fallowing, or a transition to cool season crops is the subject of ATMs and is further explored in Section 6.4 of Colorado's Water Plan.

Recent cases where agricultural producers in Colorado have improved efficiencies and overcome barriers provides context to the descriptions of the agricultural efficiency concepts provided above:

- The Uncompahgre Valley Water Users Association converted portions of its open-ditch delivery system to pipelines through the Colorado River Basin Salinity Control Program,²⁴⁹ thereby reducing seepage and delaying storage releases to better meet late season crop needs. This created the added benefit of reducing salt loading to and salinity of the Colorado River and improving downstream water quality. This is an example of a regional approach to addressing irrigation efficiency using state and federal funding to incentivize this work.
- Farmers in the Arkansas Basin converted thousands of acres from furrow and flood irrigation to sprinkler and drip application methods to stretch limited water supplies in a severely over-appropriated basin through the U.S. Department of Agriculture's Environmental Quality Incentives Program (EQIP). Water quality benefits are also achieved through the reduction of deep percolation and associated salt loading resulting from these practices. A word of caution applies to efficiency programs in the Arkansas River basin due to the unique terms of Article IV.D of the Arkansas River Compact, which expressly prohibits any improvements to irrigation systems that cause increased depletions at the state line. Because crops in Colorado typically do not receive the full amount of water that they can consume, most irrigation efficiency practices increase CU. Thus, producers who installed sprinklers and drip systems in the Arkansas basin are required to fully replace the increased depletions with augmentation water.
- The Grand Valley near Grand Junction is an area with adequate senior water rights where crops generally have a full supply throughout the growing season. Through federal programs, headgates and delivery systems were modernized thereby producing saved water through reduced diversions, to provide enhanced flows in the Colorado River for endangered fish species while simultaneously reducing saline return flows.
- The Rio Grande and Republican River Basins use alternate crops and fallowing to maintain a sustainable agricultural community in the face of an imbalance between legally available groundwater supplies and current levels of water use.
- The City of Aurora and the Rocky Ford Highline Canal have drought-driven temporary lease-fallow arrangements.
- The CWCB's Alternative Agricultural Water Transfer Methods Program supports pilot projects, such as the Colorado River Water Bank Working Group.²⁵⁰ This Water Bank Working Group is notably exploring options for reducing irrigation demands through deficit irrigation, temporary forbearance, or other means, in order to avoid, delay, or limit the likelihood or negative impacts of a Colorado River compact curtailment. The Water Bank Working Group work is further described in Section 6.4.
- Implementation of soil health practices such as low tillage, mulching, and cover crops (a crop planted to protect the soil) have improved the water holding capacity of the soil and reduced soil surface evaporation in many locations. These practices can reduce non-beneficial consumptive losses as well as making more available for crop CU. One example that demonstrates the potential of these techniques is in the Rio Grande Basin, where soil health techniques were used to both reduce water consumption and increase specialty potato crop quality and yield. Rocky Farm replaced the rotation of a barley crop with a

permanent cover crop, which uses less water, reduces soil moisture loss through evaporation, and adds organic matter to the soil. This, in turn, leads to increased soil moisture for the potato crop planted the following year.²⁵¹ This work is showcased in the Rio Grande Basin's education and tour program to promote soil health and other irrigation efficiency practices.

Recent Legislative Actions Related to Irrigation Efficiency

There are some existing legislative exceptions to the aforementioned limitations to agricultural conservation and efficiency, which are applicable in narrow instances, such as:

SB 05-133 provides that a western slope water rights holder will not be deemed to have abandoned his or her water right if certain conditions are met. Two conditions refer to "a water conservation program approved by a state agency and a water banking program as provided by law." These don't go as far as allowing sharing but it does provide that an owner of a water right won't lose the right if non-use stems from water conservation activities.²⁵²

HB 13-1130 allows a water right owner with an interruptible water supply agreement (IWSA) to request up to two additional ten-year periods for the IWSA. IWSAs enable water users to transfer a portion of their water right, called the historical consumptive use, to another water user on a temporary basis, without permanently changing the water right.²⁵³

SB 13-019 restricts a water judge from determining a water user's historical consumptive use based on water use reductions resulting from the enrollment in a federal land conservation program, participation in certain water conservation programs, participation in an approved land fallowing program or to provide water for compact compliance, or participation in a water banking program. Some water users may wish to reduce their water consumption in order to limit the effects of drought on stream flows. However, under current law there is a disincentive that penalizes appropriators who decrease their consumptive use of water. This legislation seeks to mitigate for this disincentive.²⁵⁴

SB15-183 allows court discretion in determining the appropriate period of record to utilize in calculating historical consumptive use in change of water rights cases.²⁵⁵

HB 15-1006 establishes a two-year grant program for invasive phreatophyte control and provided \$2 million each year for administration and distribution through the Colorado Water Conservation Board.²⁵⁶

Basin Implementation Plans and Irrigation Efficiency

For 2015, each basin roundtable is formulating their own implementation plan, and several include agricultural water-conservation and efficiency goals and activities.

The BIP goals for most of the roundtables indicate that they plan on increasing efficiencies and modernizing agricultural infrastructure. Several examples of these are below:

- Arkansas Basin Roundtable: Provide increased quantities of augmentation water to comply with Division 2 rules regulating increased farm efficiencies.²⁵⁷

- Colorado Basin Roundtable: Improve agricultural efficiency, preservation, and conservation.²⁵⁸
- Gunnison Basin Roundtable: Restore, maintain, and modernize critical water infrastructure, including hydropower.²⁵⁹
- North Platte Basin Roundtable: Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.²⁶⁰
- Rio Grande Basin Roundtable: Operate, maintain, rehabilitate, and create necessary infrastructure to the Basin's long-term water needs, including storage.²⁶¹
- South Platte/Metro Basin Roundtable: As measurable outcomes for the agriculture goal, this BIP intends to "support strategies that reduce traditional permanent dry-up of irrigated acreage through implementation of other solutions including conservation, reuse, successful implementation of local IPPs, successful implementation of ATMs, and development of new Colorado River supplies" and "support strategies to address agricultural water shortages through IPPs, new multi-purpose projects and innovative measures to maximize use of available water supplies."²⁶²
- Southwest Basin Roundtable: Implement efficiency measures to maximize beneficial use and production.²⁶³
- Yampa/White/Green Basin Roundtable: Restore, maintain, and modernize water storage and distribution infrastructure.²⁶⁴

Interbasin Compact Committee No-and-Low-Regrets Actions

As part of the IBCC's ongoing work, the IBCC is recommending that "Colorado will continue its commitment to improve conservation and reuse." As part of this draft work, recommendations for agricultural conservation and efficiency improvements for current and future agriculture were developed, which are incorporated into the actions below.

Actions

The following actions will support Colorado's agricultural industry to make it more efficient, resilient, and able to reduce water consumption without impacting agricultural productivity.

1. **Agricultural water incentive education program:** The CWCB will work in partnership with the basin roundtables, Colorado Energy Office, the Colorado Department of Agriculture, Natural Resources Conservation Service, and Colorado State University's extension program to develop a strategic education plan over the next two years. In addition to the topics discussed in the education and assistance program discussed in Section 6.5, the following topics will be covered:
 - a. Agricultural water conservation: Outreach to the agricultural community about available agricultural water conservation techniques and incentives;
 - b. Soil health: Begin a soil health education and tour program to help growers examine ways to increase net revenues while decreasing water inputs, and in some cases water consumption;
2. **Continue to support the rehabilitation of diversions and ditches:** CWCB will continue to provide grants, loans, and technical support to refurbish diversions and ditches to generate saved water and reduce losses where there are benefits to recreation, the environment, and other consumptive water users.

3. **Voluntary flow agreements:** Over the next two years, the CWCB and the DWR will work with agricultural and environmental partners to develop model language for voluntary flow agreements paired with irrigation efficiency practices. CWCB will also provide funding, facilitation, and technical support to encourage these agreements.
4. **Removal of invasive phreatophytes:** The CWCB will support the management and removal of invasive phreatophytes through grants that use funding provided by HB 15-1006.
5. **Explore additional incentives:** Additional incentives will be explored to assist basins in implementing, where appropriate, irrigation efficiency practices and changing crops type to a lower water use crop. These incentives should first be explored through conservation demonstration and pilot projects.
6. **New agricultural lands:** The CWCB will encourage newly developed agricultural lands (currently identified in the North Platte, Yampa, and Southwest Basins) to either be very efficient or provide direct and measurable benefits to the environment.
7. **Administrative tracking:** Over the next three years, the CWCB will work with the DWR to explore the development of administrative means to track and administer agricultural conserved water for the purposes of marketing these waters.

6.3.5 Self-Supplied Industrial Conservation & Reuse

Introduction

SSI water is a term used to describe those industrial users that have developed their own independent water supplies. This includes users such as beer producers, power plants, mining industry, and the ski industry that uses water for snowmaking purposes. However, this section will focus on the thermoelectric generation and energy extraction sectors within SSI. While SSI represents a small proportion of the water used statewide, it can be a substantial amount of water in some local areas including communities that are home to thermoelectric power generation plants or have a significant energy extraction presence, as these are the two major SSI water users. As a result, SSI water use is often addressed as part of the energy-water nexus. “The water-energy nexus is a term used to describe the interaction and interdependencies between water and energy resources. Understanding the dependencies, synergies, conflicts, and trade-offs between these two critical resources is necessary to identify and implement mutually beneficial strategies for their management and use.”²⁶⁵

Water Use in Energy Production And Extraction

Electricity Generation

Electricity generation in Colorado totaled 53,524,000 megawatt-hour (MWh) in 2013. The demand for power requires an annual consumptive use of slightly more than 55,000 acre-feet, which represents 1 percent of Colorado’s consumptive use (Colorado Energy Office calculations based on utility resource plans). Overall, electricity demand has slowed over the past half century and increased demand has been largely offset by gains in energy efficiency. Currently, the U.S. Energy Information Administration (EIA) projects relatively flat electricity load growth over time at 0.9 percent per year nationally).²⁶⁶

Thermoelectric Power

In 2012, thermoelectric facilities generated more than 85 percent of Colorado's electricity. Thermoelectric power generation heats water to produce steam that powers turbines to create electricity. While a variety of fuel types can be used to heat the water in thermoelectric power generation, the primary fuel sources in Colorado are coal and natural gas. Additionally, water is used to condense steam for reuse or discharge. The cooling process accounts for 95 percent of the consumptive use in electric generation.²⁶⁷

A variety of cooling techniques can be used in plant design based on process efficiency and an economic cost-benefit analysis. These techniques include once-through cooling, closed-loop, hybrid methods, and dry cooling.

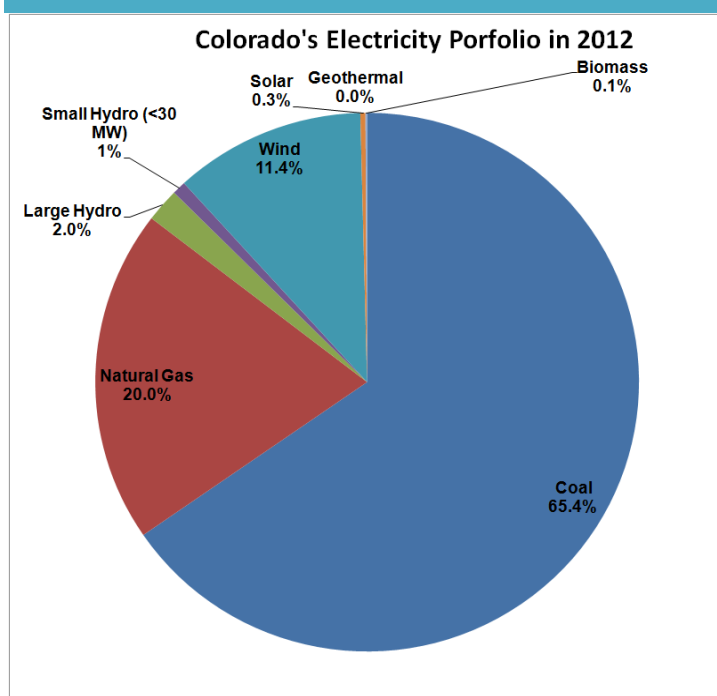
Once-through cooling systems typically require the greatest withdrawal, but have lower consumptive use because the water passes through a singular cooling process that absorbs heat and is then discharged. Historically, this was often the least expensive and most used method nationwide, but it can have a greater ecosystem impact because of warm water discharge. Once-through cooling systems are not used in Colorado.

Alternatively, closed-loop cooling systems use cooling towers to condense the steam. This requires comparatively lower withdrawal, but

because of recirculation has a higher consumptive use rate. Many of Colorado's electric generating units use this method, including Xcel's Arapahoe Station, Comanche Station Units 1 and 2, Cherokee Station, and Tri-state G&T's Craig Station.²⁶⁹ Some facilities minimize freshwater consumption by using treated closed-loop systems. For example, the Platte River Power Authority's Rawhide coal generator relies on 87 percent treated effluent water and their natural gas turbines use closed-loop glycol cooling systems.

Two other cooling systems are being researched and employed, in an effort to reduce water consumption, that use ambient air cooling called dry cooling. Dry cooling uses only ambient air to condense steam, it has lower plant efficiency, it has a greater land footprint, and it requires a higher electric load that increases the expense of this method. Nevertheless, hybrid air and water systems that employ both techniques in concert are becoming more prevalent such as Xcel's Unit 3 at the Comanche Station.

Figure 6.3.5-1: Colorado's 2012 Electricity Portfolio²⁶⁸



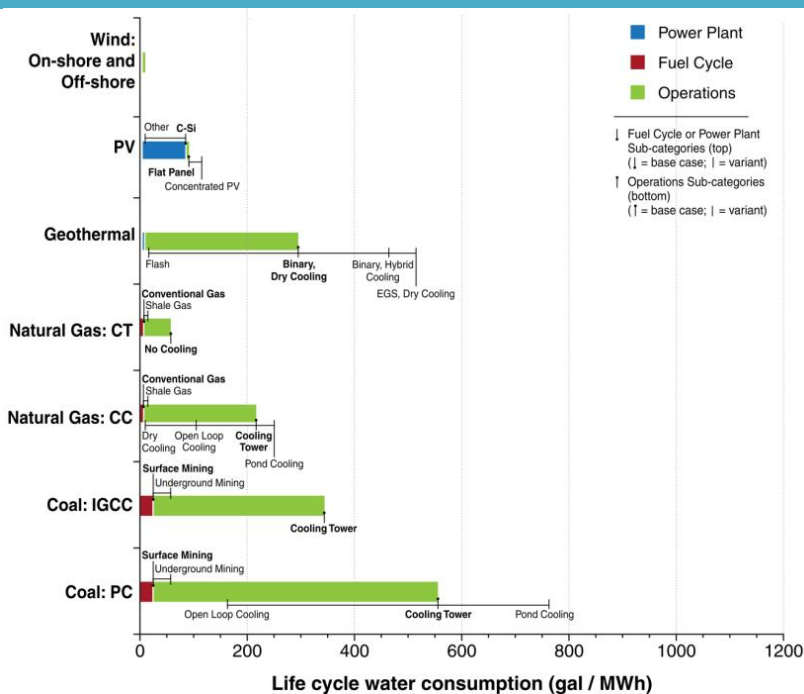
While coal and natural gas are the primary fuel sources for electricity generation in Colorado accounting for 65 percent and 20 percent in 2012, respectively (Figure 6.3.5-1), each requires different amounts of water for their process (Figure 6.3.5-2). Coal plants consume on average roughly 40 percent more water per MWh produced when compared to combined cycle natural gas plants when controlling for all cooling system types.²⁷⁰ Nevertheless, the cooling techniques employed at each facility are the primary source of consumption regardless of the fuel source.

Outside of the generation requirements, both fuel types also require minimal amounts of water to extract and deliver the resource to the plant.

Renewable energy generation can have consumptive water use depending on the technology, but overall renewable energy requires substantially less water than fossil fuel generation. In 2004, Colorado voters passed Amendment 37, establishing a Renewable Electricity Standard requiring utilities to generate a portion of their electricity from renewable sources. The legislative declaration for Amendment 37 specifically included language, among other public policy goals, that the measure would “minimize water use for electricity generation.”²⁷²

Currently, Colorado’s renewable electricity standard requires 30 percent generation for investor-owned utilities, 20 percent for co-ops, and 10 percent for municipal utilities, all by 2020. Additionally, in 2010, Colorado’s legislature passed the Clean Air Clean Jobs Act, which sought to reduce emissions from power plants by retiring, retrofitting, or repowering some power plants owned by Xcel Energy and Black Hills Energy. Because of these state-level policies, a variety of EPA regulations and increasingly competitive wind and solar prices, Colorado is likely to reduce water use in electricity generation as Colorado’s generation portfolio trends toward a larger mix of natural gas and renewable generation. In fact, generation from wind has grown the fastest of any fuel source as a percentage of the overall portfolio, more than 12 percent from 2005 to 2012, and represents both the state’s largest renewable energy generation source and the utility-scale source of electricity with the least consumptive use of water.

Figure 6.3.5-2: Life Cycle Water Consumption for Various Methods of Energy Production²⁷¹



Public Disclosure and Resource Planning

Colorado's investor-owned utilities, Xcel & Black Hills, report their water consumption when filing resource plans with the Public Utilities Commission (PUC). The PUC is also allowed to consider water use in addition to fuel costs, construction costs, conventional operating costs, and transmission costs when evaluating resource selection. Investor-owned utilities in Colorado are also permitted to use water consumption as a factor while prioritizing and evaluating competitive solicitations for renewable energy.²⁷³ Tri-State G&T provides water consumption data to the PUC as part of their public resource planning process.

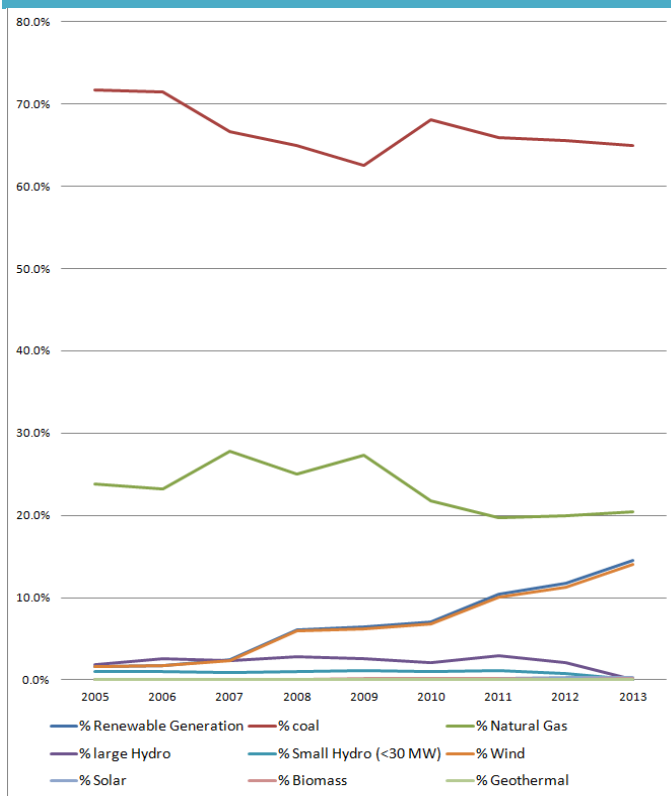
Hydroelectric Power Generation

Currently, hydropower provides around 4 percent of Colorado's electricity, generated from more than 60 hydropower facilities throughout Colorado. With a combined installed capacity of 1162 megawatts (MW), the hydroelectric facilities produce roughly 1 million MWh of electricity annually. Colorado's hydro plants range in size from 5 kilowatts to 300 MW and include three pumped storage facilities. While Colorado has an arid climate, the state has potential to further develop hydroelectric resources.

Colorado's hydroelectric resources can be categorized into three areas; large hydro, small hydro, and agricultural hydro. Each project category has unique characteristics and affects water consumption in different ways. Typically, larger hydroelectric projects (generating capacity) have larger evaporative losses because of the need for sizable dams and reservoirs. While Colorado has 6 projects classified as large hydro (over 30 MW), these projects are still relatively small in size compared to others around the country. While there is no widely accepted definition of "small hydro," small hydro projects in Colorado are typically 2 MW or smaller in size.

Agricultural hydro includes a variety of system types, including pressurized irrigation systems. There are roughly 2.7 million acres of land under irrigation in Colorado. A Colorado Department of Agriculture (CDA) analysis found that 7 percent of these lands, or approximately 175,000 acres, are candidates for pressurized irrigation systems. Of those candidate lands, 13 percent are already sprinkler irrigated and would have the lowest development cost. The remaining 87 percent are predominantly flood or furrow irrigated and would have a higher cost for agricultural hydro development because of the necessary redesign and retrofits.²⁷⁴

Figure 6.3.5-3: Colorado's Electricity Portfolio (Net Generation)



Gravity-pressurized irrigation systems, e.g., a center pivot sprinkler, have potential to generate electricity if there is either excess flow or excess pressure available, or if the center pivot system currently relies on diesel generators or the electrical grid. The hydroelectric generating potential (in excess of the power needed to pressurize the irrigation systems themselves) of Colorado's pressurized irrigation systems was estimated at 30 MW. Depending on the situation at a given parcel, excess hydroelectric power could be used to offset other electrical loads or to mechanically drive the sprinkler system itself.²⁷⁵

Various organizations, including federal agencies, have explored the hydropower potential of existing agricultural dams. There are more than 2000 dams in the State of Colorado, a large number of those dams are very small or only hold water for a very short period of time. A Colorado Department of Agriculture (CDA) study into the use of small dams excluded dams that were not related to agriculture, on federal lands, or were so small that they were very unlikely to hold potential. The CDA study found 102 small dams statewide with the technical potential to generate hydroelectricity. Twenty-three sites were found to be economically feasible and could break even within 20 years. Those 23 economically feasible sites total approximately 40 MW of capacity, 25 MW of which are currently under development (six projects). This leaves about 15 MW of untapped, economically feasible potential throughout the state.²⁷⁶

Opportunities for additional large hydro projects in Colorado are limited as most of the ideal sites have already been developed. Nevertheless, small hydro and agricultural hydro systems have better outlooks for future growth. According to the Bureau of Reclamation, Colorado currently has more than 30 potential hydropower sites at Reclamation facilities with the potential to produce more than 105,000 MWh annually.²⁷⁷ A U.S. Department of Energy report estimates an additional 11 potential sites with the potential to produce more than 632,000 MWh annually.²⁷⁸ Between these two studies, Colorado's estimated untapped hydropower energy potential is more than 737,975 MWh annually. If Colorado were to use this full potential, it could power more than 65,000 homes a year using new hydropower.

Oil and Gas Production

There are more than 52,000 active oil and gas wells in Colorado. Oil and gas development accounts for less than one tenth of 1 percent of the overall water usage in the state. The primary uses for water are in the drilling and completion phases. This includes cooling the drill bit and bringing drill cuttings to the surface as well as the hydraulic fracturing (fracking) process. During hydraulic fracturing, water mixed with sand and chemicals is pumped down the wellbore under high pressure to create tiny fractures in the rock that release oil and gas. Water usage for oil and gas operations varies, depending on the type and location of the well and whether or not the well is hydraulically fractured. Vertical and directional wells use less water than horizontal wells because they are not as long and require lower pressure. Vertical and directional wells typically use between 100,000 and 1,000,000 gallons of water, depending on the depth of the well. Horizontal wells typically use between 2,000,000 to 5,000,000 gallons, depending on the depth and length of the well.

The Colorado Oil and Gas Conservation Commission (COGCC) began requiring oil and gas operators to report the volume of fluids used in hydraulic fracturing in June 2012. In 2012, approximately 7.3 billion gallons of water was used for 2294 well starts, including 664 horizontal wells. Of this total

volume, about 3.8 billion gallons (53 percent) were reported to be recycled fluids. So far in 2014, approximately 4.2 billion gallons of water has been used for 1609 well starts, including 1081 horizontal wells. Of this total volume, about 1.2 billion gallons (29 percent) were reported to be recycled fluids.²⁷⁹

COGCC does not formally track reuse of produced water. Anecdotally, the most significant reuse of produced water is for hydraulic fracturing. Since the produced water contains chemicals and naturally occurring hydrocarbons, its use off of the well site is tightly controlled by COGCC and Colorado Department of Public Health and Environment regulations. Operators are currently testing and implementing new treatment technologies to allow for the reuse and recycling of produced water for other purposes.

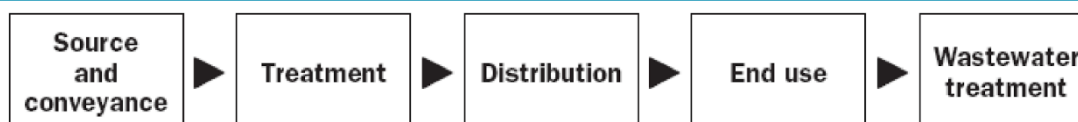
Coal Extraction

There are nine actively producing coal mines in Colorado. Most of the water in coal extraction is for mining, washing, and transporting coal, including dust suppression efforts. Consumptive water use at these coal mines ranges from 26 to 320 acre-feet per year, with an average of 165 acre-feet (1,000,000 gallons = 3 acre-feet).²⁸⁰ A few mines are implementing water efficiency measures. For example, the West Elk Mine in Delta County uses a closed loop system, pumping all surface runoff into the mine for use in its wash plant and dust suppression efforts. The mine only rarely pumps water from the North Fork of the Gunnison River and discharges back to the river have been minimal and rare.

Energy Use in Water Conveyance

The other piece of the water-energy nexus is the energy that is required for water conveyance, water treatment, water distribution, and wastewater treatment. The 2009 study, *Water Conservation = Energy Conservation: A Report for the CWCB* stated that, “Energy is embedded in water. Water utilities use energy to pump groundwater, move surface water supplies, treat raw water to potable standards, and distribute it to their customers. Customers use energy to heat, cool, and pressurize water; and wastewater treatment plants use energy to treat wastewater before discharging it (Figure 6.3.5-4).”²⁸¹

Figure 6.3.5-4. Energy Is Used To Pump, Treat, Distribute, and Use Potable Water, and To Treat Wastewater²⁸²



Concerning domestic water, the water-energy nexus is centered on water conservation measures that can be employed to lessen the energy intensity of water use. Water supplies carry vastly different energy intensities depending on where they originate and how they are conveyed. Some water supplies are almost purely conveyed using gravity, while other supplies are very energy intensive requiring a large amount of electricity to pump water from deep underground.

Water conservation and energy efficiency can play synergistic roles in lessening the impacts of the other. Through more efficient changes in water treatment, distribution and end use, energy use can be made more efficient and vice versa. This can extend back to saving energy in the SSI area of energy production, thus saving water that would normally go into the process of producing this energy.

Energy and Water Efficiency Tools

Many of Colorado's efficiency programs include savings from water with energy savings. Although reducing water use alone can save energy, Colorado's efficiency programs generally focus on improving water efficiency and energy efficiency during a complete facility renovation.

Energy Performance Contracting is a tool that allows public facilities to finance capital improvements, including upgrades to efficient equipment. They allow the facilities to contract an energy service company to conduct investment-grade audits to facilities and obtain prioritized lists of facility improvement measures. By pursuing those measures through a performance contract, energy service companies guarantee that the facilities will realize energy, water, and associated operations and maintenance savings from the proposed improvements. In Colorado, Energy Performance Contracting has been used to finance \$447.4 million in facility investments. Those investments provide guaranteed annual savings of 141.8 million kWh of electricity, 9.95 million therms of heating fueling, 467,200 kgal of water, and \$30.9 million annually.

The Colorado Energy Office also manages an Energy Savings for Schools Program that helps lower energy, water use, and costs in K-12 school districts, while improving building performance and comfort. The services and resources of this program are designed to cover the variety of energy efficiency and energy management needs of schools. Colorado schools located in rural or lower income districts are particularly affected by high energy costs and are a high priority for engagement through the Colorado Energy Office's energy efficiency programs.

There is also significant potential for efficiency savings among agricultural communities. The CDA is working with agricultural producers in Colorado to reduce energy and water costs. Some of these efforts also reduce thermoelectric energy use with its concomitant water savings. Projects include locally-sited micro hydro, solar, and wind power generation.²⁸³ In addition, the Colorado Energy Office developed an agricultural efficiency pilot with dairy farmers, which focused on energy efficiency improvements but could be further developed to include water efficiency measures.

Through Senate Bill 14-171, the Colorado legislature expanded another energy efficiency program to water use savings last year. Commercial Property Assessed Clean Energy Bonds previously allowed commercial building owners to arrange financing, secured by a lien, for the installation of energy efficiency improvements. Senate Bill 14-171 allows water conservation fixtures to be included in the improvements, so that buildings can benefit from both energy and water efficiency.

Actions

1. Examine the feasibility of water-energy nexus programs that conserve both water and energy. Some concepts to further explore include:
 - a. Joint water and energy home or commercial audits

- b. Joint rebate programs, which combine water and energy utility rebates to most effectively incentivize customers to purchase a specific energy/water efficient appliance
 - c. Treat water utilities as a large customer of the energy utility and explore system-wide water/energy reducing measures, such as reducing distribution system leaks.
2. When exploring new water supply projects, opportunities for renewable energy to meet the increased demands should be considered.
3. Outreach to energy companies to encourage and promote the most water efficient technologies for energy extraction.
4. Colorado's Energy Office will continue to support energy saving associated with on-farm agricultural practices that also reduce water use.
5. The CWCB will work with Colorado's energy office and local agricultural producers to financially and technically support a pilot that combines renewable energy development with an alternative agricultural transfer to lessen the potential economic impacts to the local community.
6. The CWCB will encourage energy companies to continue collaborating with agricultural and environmental interests when managing their water portfolio.
7. The state will help to protect critical infrastructure by working with power providers to identify areas of their systems prone to failure or impact during water shortages and natural disasters.
8. The state will work with power providers to mitigate for the possibility of curtailment in severe droughts and diversify their water rights portfolio.
9. Encourage demand-side management,
 - a. Through continued support of research into innovative ways to reuse produced water.
 - b. Decrease vulnerability during times of water shortages.
10. Encourage technologies that reduce water use in energy extraction processes.

6.3.6 State Agency Conservation

The State of Colorado plans to increase conservation efforts within state facilities to help demonstrate the ability to save water. The Colorado Energy Office has been facilitating the Greening Government initiative since Governor Bill Ritter issued Executive Orders D 0011 07 and D 0012 07. The Greening Government Leadership Council recently generated a new draft goal for water demand reduction at state facilities. This goal will be achieved by 2020 with a baseline of 2015 and will be normalized for weather and other external factors.

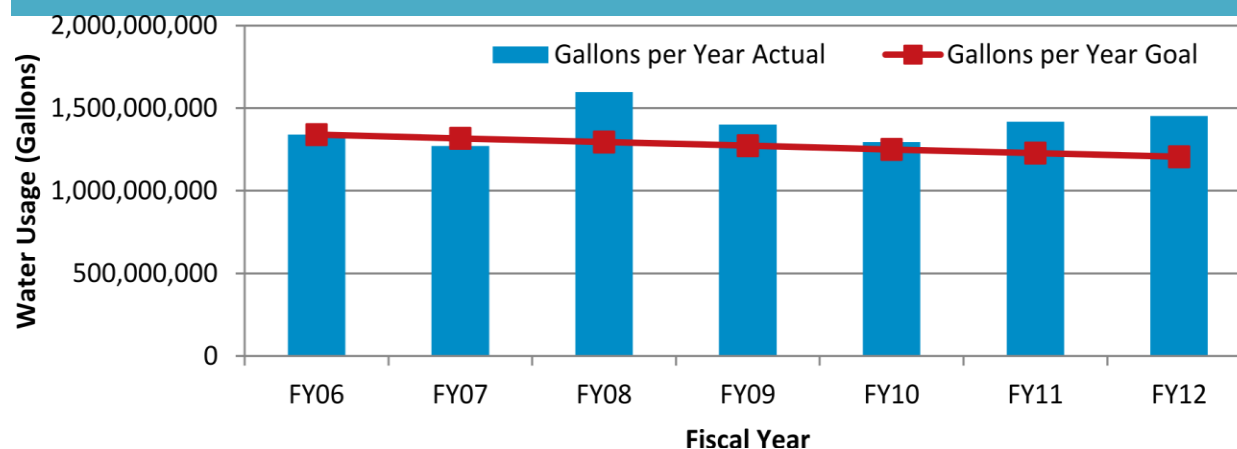
Water goal: *Collectively, all executive State agencies and departments shall reduce potable water consumption by a minimum of 1 percent annually (normalized for weather) and at least 7 percent by FY 2020 relative to an FY 2015 baseline.*

State agencies reduce their water consumption by various methods such as installation of efficient plumbing fixtures, advanced lawn irrigation controls, and taking advantage of re-use water.

The following is taken from the 2012 Greening Government Annual Report Card.²⁸⁴ The state saw an increase of 8.4 percent (112.5 million gallons of water) in water use. Each agency provided the

following data and it reflects their best attempt to record all water purchases between FY'06-FY'12 in EnergyCAP. Water usage has not been normalized for the increase in state employees, increasingly hot weather, or new water-intensive industries. Of the 14 agencies and departments with owned square footage, six reduced their water use by more than 10 percent, four reduced their water use by less than 10 percent, and four increased their water use.²⁸⁵

Figure 6.3.6-1: Water Use (Actual and Goal) Through Time



Exemplary State Agency Projects

1. Colorado Department of Health and Environment decreased its water use by 11 percent since 2005. They replaced 2 acres of bluegrass lawn with xeric grass species, which is saving more than 2.5 million gallons per year. They also replaced high flushing urinals with 0.5 gallons per flush urinals and installed waterless urinals.

2. Capitol Complex facilities personnel conducted some notable efforts over the last few years. They worked with Denver Water to audit all cooling towers for the Capitol Complex and can reduce consumption by almost 500,000 gallons per year. Additionally, they can now take advantage of Denver Water incentives. Another example that is not captured in this annual report is a landscape transformation initiative that is taking place on the Capitol grounds. A collaborative group from the Governor's Office, CWCB, Denver Water, the Denver Botanic Gardens, Colorado Nursery and Greenhouse Association, and Capitol Complex Facilities is working on plans to reduce water consumption and demonstrate the benefits of water wise landscaping on the Capitol building grounds. This high profile project will highlight to the public what can be done with Colorado appropriate landscapes.

Recommendations from Annual Report Card

- Continue requiring water reductions by all state agencies.
- Require agencies to take advantage of free or reduced cost water audits by their water utility, if applicable.
- Look into bulk purchasing of water efficient appliances for state agencies.
- Continue educating Council about the water-energy nexus.
- Research and identify alternative ways to provide sufficient funding for water efficiency.
- Continue encouraging agencies to use their water rights.

This water use is an important standard to strive for in that the State should lead by example in its own facility water use. This idea ties back to the philosophy of the SWSI Levels Framework where water providers should prioritize their foundational activities first and then focus on what they have direct control over within their own facilities. While much has been done at state facilities, better tracking and quantification could take place to normalize the data for weather, number of employees, and any new intensive uses that have come online.

Actions

CWCB will provide grants and technical support to state agencies for the installation of high efficiency toilets and urinals, replacement of turf grass with plants that use less water, and improvement of cooling towers.

6.4: Alternative Agriculture Transfers

Colorado's Water Plan will respect property rights and the contributions of the agricultural industry by maximizing options for alternatives to permanent agricultural dry-up.

Background

Agriculture uses the largest amount of water in Colorado and is the economic backbone for many rural communities. It supports important environmental attributes, strengthens Colorado's food security, and upholds our cultural identity. There are approximately 66.3 million acres of land in Colorado, of which 10.6 million acres are cropland.²⁸⁶ Global, national, and state population growth will place additional pressure on our food sources, which means that the long-term economic viability of agriculture is strong.²⁸⁷ Local economies in rural areas depend on wholesale, retail, banking, and support services related to agricultural production. When farmers stay in agriculture, cash flow related to their operations can increase the vitality of their communities. Agriculture is an important contributor to Colorado's economy as a whole, which is further discussed in Chapter 5.

Respect the contributions of the agricultural industry by maximizing options to permanent buy-and-dry. Achievement of a sharing goal of 50,000 acre feet could serve up to 350,000 people annually.

Pressures at the state, national, and international level threaten to reduce agricultural lands in the short-term. Future municipal water demands contribute to an increasing pressure to transfer agricultural water rights to help satisfy urban demands and other non-agricultural water needs across the state.²⁸⁸

Agricultural interests are concerned about the possibility of drying up more agricultural lands in the future.²⁸⁹ If Colorado continues down its current path, the South Platte River Basin could lose up to one-third of today's irrigated land by 2050.²⁹⁰ The Arkansas River Basin could lose another 17 percent of its total.²⁹¹ The main stem watershed area of the Colorado River Basin could also lose another 29 percent of its irrigated lands.²⁹² Reduction of irrigated lands can be measured as actual acres lost, but can also be measured in economic terms based on a reduction of crops being irrigated before the water transfer.

The SWSI estimates that by 2050, Colorado may lose 500,000 to 700,000 acres of currently irrigated farmland to meet municipal growth demands. The IBCC and basin roundtables conclude

that the current status quo path of buy-and-dry is not the best path for Colorado. Across the state, water stakeholders want to minimize buy-and-dry in a way that respects property rights, recognizes the importance of agriculture in Colorado, and supports a sustainable agricultural industry, while identifying solutions to provide water for municipal needs. As indicated by numerous groups, including the Colorado Agricultural Water Alliance and the IBCC, there are a variety of alternative options that have the potential to appreciably decrease the projected permanent losses of irrigated acres in Colorado.

These options, referred to as ATMs, do not limit the choice of private water right owners to permanently sell their water rights. ATMs offer voluntary, not mandatory, tools for both farmers and water users to depart from the status quo. In addition, ATMs can be used to support the environment, recreation, industry, and groundwater sustainability and through the creation of water banks to reduce demands on a water system. ATMs are flexible enough to focus on reducing net profit loss or, on the other hand, can help to protect higher value crops for economic benefits.

The Low to No regret scenario planning, discussed in Section 6.1, indicates that the minimum goal of water needed from ATMs to meet the planning outlook is approximately 50,000 acre-feet, or enough water to serve as many as 350,000 people. This amount would reduce permanent transfer of agricultural water rights but would still result in agricultural dry up. Currently, ATMs are more expensive and legally burdensome than traditional buy-and-dry approaches that permanently transfer water rights, making it difficult to obtain the estimated amount of water from existing alternatives. There are many creative and cutting edge alternatives (as shown in Table 6.4-1) that can help decrease permanent reductions in irrigated acreage.

Goals of ATM Programs

Short-term or long-term temporary water transfer alternatives provide options that address concerns about permanent agricultural buy-and-dry. Program goals related to ATMs are aimed at specific objectives for various regions across Colorado. It is highly unlikely that any one concept will be universally accepted in every basin. Rather than a one-size-fits-all approach, we understand that a variety of alternatives will be needed to meet specific needs. The goal of alternative water transfers is to benefit the agricultural community, as well as cities and towns that are seeking viable sources of water supply to keep up with demands. The state has learned important information about developing, evaluating, and monitoring ATMs from pilot and demonstration projects, but has more to learn to fully understand the potential of ATMs.

To achieve widespread implementation of ATMs across the state, researchers need to build a deeper understanding of their challenges and opportunities. To do so, the state needs more data and measurements on the outcomes from actual case studies. Researchers need to collect more information to be able to quantify results and inform decisions. In addition, there are significant legal, technical, and financial barriers to implementing ATMs. An in-depth look at existing ATMs and future project models will help identify program constraints and how to address them. There is the potential for tremendous local, statewide, and regional benefits, but stakeholders need further information to expand their knowledge and ability to implement projects.

Table 6.4-1: Types of ATMs Promoted in Colorado

<p>Rotational fallowing – Rotational fallowing keeps land in irrigated production mode while systematically fallowing specific plots. A rotation occurs to systematically fallow each plot in successive crop seasons. It allows leased water to become a base supply for a municipality, while keeping most the farming operation in production. It also works very well for drought supply, drought recovery, and conjunctive use. Revegetation protection, erosion control, and weed control of the fallowed plots are important considerations for this type of ATM.</p>
<p>Interruptible supply agreements – This type of ATM is between non-agricultural water users and farmers, shareholders, or a ditch company. Water is temporarily transferred from agricultural use to another use, such as municipal. Farms are fallowed during specific periods of time, and water is leased to the end user based on the historical consumptive use portion of the water right. These arrangements are done through contractual agreements that satisfy the authorizing statutes. This could also include water conservation easements. See examples below.</p>
<p>Municipal-agricultural water use sharing – This concept embodies a complex array of options based on continued farming operations for all lands associated with the sharing arrangement. Methods are used to reduce the consumptive use of crops, which makes water available for municipalities by sharing the historic consumptive use amount. Two main sub-categories are continued farming and deficit irrigation. In deficit irrigation, crop watering is strategically limited to save water for other uses. Plants are typically stressed, but production and crop yield still occur.</p>
<p>Water cooperatives – This concept identifies periodic excess water supplies that can be used for optimization in the system. It includes use of surplus augmentation water and other supplies. The framework for moving water from one use to another involves mutually beneficial transactions that work within the existing system of water rights so that no injury occurs.²⁹³ The Lower South Platte Cooperative is a current working example of this type of ATM.</p>
<p>Water banks – A water bank acts as an intermediary or broker based on water supply arrangements with owners of certain water rights. The bank could be used to avoid or endure a compact curtailment, for example.²⁹⁴ Irrigators would be paid to reduce their consumptive uses, which could trigger fallowing of agricultural lands or deficit irrigation practices on a temporary basis. The saved water could be banked in a reservoir for later release into the system. This approach is being regularly discussed and studied in the Colorado River Basin.</p>
<p>Flex markets – These ATMs are defined as voluntary agreements between municipal and industrial water users, agricultural water users, and environmental/conservation water users.²⁹⁵ The idea is to change the use of a senior irrigation right to include multiple end uses in addition to irrigation. Flex markets establish trading platforms to help provide water used by all participants. The goal of this approach is to allow part of the senior right to be used by cities and towns and for environmental purposes based on contractual arrangements. The economic benefit of the senior water right is kept in place by maintaining enough agricultural water to sustain robust farming operations.</p>

Potential impediments to ATM success

Executing ATMs at this time can be difficult, or sometimes impractical, because of institutional, legal, financial, and court-related barriers, and the type of operation. For example, rotational fallowing would not work on an established orchard since the trees would not survive without water for a growing season. Some legal impediments include long-standing water court procedures that change water rights and legal requirements for ATM applications to prevent injury to other water rights. New and creative ATM ideas face many challenges because they do not fit into the historic way of dealing with water rights.

Other obstacles to success include irrigators' concern regarding the outcome of historic consumptive use analyses and the potential for expanded uses of changed water rights. Cities and towns wonder if temporary supplies will actually be available when needed over the long haul.²⁹⁶ Another impediment is the lack of necessary infrastructure for water transfers and the inability to form agreements depending on the seniority of water rights or productivity of the lands involved.²⁹⁷ Transaction costs tend to be relatively high, which can discourage potential water transfers. In addition, we need to assess fair and effective pricing for farmers and water suppliers,

and the ability for farmers to invest ATM revenues back into their operations. To avoid the problem of where and how to store ATM water, we need to better understand and define the infrastructure that may be needed. Infrastructure improvements, expanded reservoir operations, or reservoir re-operations may bring needed utility and flexibility for storing ATM water. We believe that it would also be helpful to provide a means to support prioritization of research and investments into technology systems such as automated delivery techniques.

Colorado's Water Plan encourages all interested parties to openly and constructively find ways to adapt to changing times. Colorado's Water Plan recognizes that water-sharing agreements between municipalities and agricultural interests for water transactions, such as the sale or lease of surplus water and use of excess return flows, can be an important tool in moving forward to meet supply gaps. To alleviate water supply pressures, stakeholders need to find solutions to reduce barriers to implementing ATMs for enhanced success. The strength of Colorado's agriculture is its diversity. A full mandate of ATMs across all sectors is not the answer, whereas creative options and solutions can be applied to feasible situations. Successes could be gained and barriers overcome based on creativity at the grass-roots level, which then could generate momentum at ditch and basin levels.

Examples of ATMs

There are a variety of existing examples of how ATMs work in Colorado. A few are illustrated below.

- *Morgan Ditch Company & Xcel Energy* formed a voluntary lease arrangement in the South Platte River Basin. For more than 20 years, a separate water company developed under the Morgan Ditch Company has provided firm yield supply to Xcel Energy's Pawnee power station. It is located conveniently near the ditch system on the eastern plains south of Brush, which allows for several options to physically deliver the water to the power station. While a traditional water court process was used to codify the legal ability to transfer water from agricultural use to industrial use, the arrangement has built-in flexibility to handle wet, average, and dry years. The dry year deliveries typically involve temporary dry-up (fallowing) of sufficient farmland under the ditch to meet delivery requirements to Xcel. It also means that remaining farmland is fully irrigated with senior direct flows or senior reservoir rights. In those cases, the system does not operate in a deficit irrigation mode to apply water to all lands during the really dry years. The mutually beneficial agreement is desirable in the eyes of those in the system and has a proven track record of success, providing an example of how industrial interests and farmers can continue to operate.
- *Lower Arkansas Valley Water Conservancy District* provided an economic and engineering analysis of the Lower Arkansas Valley Super Ditch Company (Super Ditch). The Super Ditch allows irrigators under a group of ditch companies to collectively lease agricultural water for other uses, including municipal use. The Super Ditch acts as a negotiating entity for irrigators who are interested in leasing water for temporary use by cities, towns, water districts, and other users.²⁹⁸ The farmers still retain ownership of their water, keeping farms in operation for agricultural sustainability.
- *The Water Bank Working Group* consists of the Colorado River Water Conservation District, the Southwest Water Conservation District, the Front Range Water Council, the Nature Conservancy, the CWCB, and other interested parties. The working group is investigating the feasibility of a water banking program within the Colorado River Basin. In the short-

term, the water bank could operate as part of the demand management component of the state's contingency plan to prevent Lake Powell from dropping below critical levels. In the long-term, a water bank could help prevent shortages under the Colorado River Compact and help Colorado water users during regional shortages. The Water Bank Working Group engages with agricultural users to gauge interest in participating in the program and to identify potential costs or compensation for involvement. The "Colorado River Water Bank Feasibility Study," released in March 2012, details potential uses for such a program as well as potential sources of supply. The preliminary study modeled the potential frequency of situations where a water bank would be useful. The study examined several scenarios that showed water bank annual use estimates and an estimate of the number of irrigators willing to participate. The CWCB is examining additional studies about the water bank.

- *City of Aurora & Rocky Ford Ditch* partnered for a creative water transfer arrangement to allow continued farming. Aurora invested to help purchase highly efficient irrigation equipment (e.g. drip or sprinkler technology) for farming operations. Farmers also received augmentation water from Aurora to supply new wells for irrigation rather than using water directly from the Rocky Ford Ditch. Several farmers have maintained strong agricultural production by using augmentation supplies for depletions from the well use on their farm. The farmers have reduced their consumptive use by switching to crops that need less water. This arrangement still maintains a healthy agricultural operation. For successful outcomes, municipalities offer strong financial commitments and the farmers offer willingness and flexibility to modify their traditional practices.
- *City of Aurora & Rocky Ford Highline Canal* partnered for a water leasing agreement in 2004 and 2005. Farmers under the Rocky Ford Highline Canal directly leased water to the City of Aurora. Coming to an agreement took a substantial amount of time and included complex contracts between the City, individual farmers, and the canal company. It also required approval of a substitute water supply plan from the Division of Water Resources at that time. Nevertheless, newer statutory authorizations for interruptible water supply agreements assist in the implementation of these types of ATMs. Intermittent leases of this nature are used to fill a specific need including drought relief and the recovery of reservoir levels following drought. They could also supplement base water supplies during dry periods.
- *Ducks Unlimited* partnered with Aurora Water and Colorado Corn Growers Association to develop augmentation ponds that support water fowl.
- *Metropolitan Water District of Southern California & Palo Verde Irrigation District* agreed to a land fallowing, crop rotation, and water supply program.²⁹⁹ They began the 35-year agreement for voluntary water transfers in 2004 to help to meet California's urban water demands through a mutually beneficial partnership. The program is designed to supply 25,000 to 118,000 acre-feet annually by temporarily drying up 7 to 28 percent of the irrigated farmland in the Palo Verde Valley.³⁰⁰
- *The Lower Arkansas Valley Water Conservancy District and Super Ditch, LLC* submitted a pilot project proposal and then a full application to the CWCB in 2014, which was ultimately approved by the Board. The pilot began during the 2015 irrigation season and involves temporary transfers of water from certain agricultural lands on the Catlin Canal system to

the communities of Fowler, Fountain, and Security. This project will assist in helping us to learn from an actual ATM being implemented in the basin.

ATMs grant program overview

Colorado's Water Plan encourages alternatives to permanent dry-up. One way Colorado continues to address ATMs is through the CWCB's long-standing grant program. Colorado Senate Bill 07-122 authorized the ATM grant program, which applies to a wide array of issues related to lease-fallowing, pilot projects, flex market studies, demonstration efforts, and other alternatives for a

variety of beneficial uses of agricultural water supplies. Nearly two dozen grants have been awarded, ranging from about \$8000 to almost \$500,000 each. The program was initially funded with a total of \$4 million, with an additional \$750,000 approved in the CWCB 2015 Projects Bill (Colorado House Bill 14-1333). Detailed summaries of the program and awarded grants are available from the CWCB.³⁰¹ The ATM grant program assists in developing and implementing creative alternatives to the traditional purchase and permanent transfer of agricultural water.

ATM related existing legislation

Colorado's Water Plan recognizes the need to increase flexibility within Colorado's system of water law, while respecting individual property rights. ATMs could provide a viable option for municipal water providers now and in the future. The key to the success of ATMs is to develop methods that meet the needs and respect the property rights of the agricultural water rights owners. ATMs can also provide long term security and financial practicality to urban water providers. State legislation influences the availability of tools necessary for the further facilitation of ATMs. One important legislative bill related to a fallowing-leasing pilot program is discussed here as a relevant tool for this section. Colorado House Bill 13-1130 enacted legislation for Interruptible Water Supply Agreements. The associated statute supplemented or amended previous authorizations. This legislation allows for a temporary change of an absolute water right for a new use once approved by the Colorado Division of Water Resources, or the State Engineer's Office.³⁰² The statute does not require the arrangements to go through a typical water court process. See table 6.4-1 above for a general description of this type of ATM.

The Fallowing-Leasing Pilot Program authorized by Colorado House Bill 13-1248 (HB13-1248) was signed into law by Governor Hickenlooper on May 13, 2013. It allows for a pilot program to test the usefulness of fallowing-leasing as an alternative to permanent agricultural buy-and-dry.³⁰³ The pilot program may include up to 10 separate pilot projects statewide; however, no more than three are allowed in any single river basin. Each pilot can operate for up to 10 years in duration.

Figure 6.4-1: Rotational Fallowing*



* Once farmed, certain plots of land are systematically fallowed to provide temporary water that is leased to municipalities. The fallowed plot can be planted with non-irrigated vegetation to prevent blowing soils.

In HB13-1248, the Colorado General Assembly declared its commitment to develop and implement programs to advance various agricultural transfer methods as alternatives to permanent agricultural dry-up. It further stated that Colorado needs to evaluate whether fallowing-leasing is a practical alternative to traditional “buy-and-dry” methods.³⁰⁴ The General Assembly designated the CWCB as the appropriate state agency to test the efficacy of implementing fallowing-leasing.

HB13-1248 charged the CWCB, in consultation with the State Engineer, to establish “criteria and guidelines” for the application, selection, and approval process for pilot projects. A set of criteria and guidelines was developed through the cooperation and collaboration of the CWCB, the State Engineer’s Office, and the public in accordance with that legislative directive. They assist the CWCB and interested parties with carrying out the spirit and intent of HB 13-1248.³⁰⁵

HB13-1248 allows fallowing-leasing pilot projects to be tested in an effort to overcome challenges and to develop and demonstrate opportunities for temporary agriculture-to-municipal water transfers.

The Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Valley Super Ditch Company, Inc. formally submitted a proposal to the CWCB’s staff on July 14, 2014 for a fallowing-leasing pilot project under the auspices of HB13-1248 and the CWCB’s Criteria and Guidelines for the Fallowing-Leasing Pilot Projects. At its September 2014 board meeting, the CWCB approved the proposal to move forward on the full application. The sponsors then submitted an application, which involves transfers from certain shares of agricultural water from farmland irrigated by the Catlin Canal, within Otero County, for temporary municipal uses by the Town of Fowler, City of Fountain, and the Security Water District. The project proponents aim to carry out the pilot operation beginning in the 2015 irrigation season (see also the Examples of ATMS section above).

More recently, SB 15-198 was signed into law by the governor, which expands upon the authorities in HB 13-1248. The pilot program may now include temporary transfers from agriculture to agriculture, agriculture to the environment, agriculture to industry, and agriculture to recreation.

BIPs

Final BIPs were submitted to the CWCB in April 2015 and provided valuable information regarding each basin’s plans for agricultural needs, which are summarized below.

The Arkansas BIP has three goals associated with ATMs. First, “Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions” by continuing the ATM process of engineering, public policy, and pilot projects.³⁰⁶ Second, “Provide increasing quantities of augmentation water for increased farm efficiencies” by establishing long-term sources of augmentation water through leasing, water banks, or interruptible supply agreements.³⁰⁷ Third, “Develop a viable rotational fallow and/or leasing program between agriculture and municipal interests to address drought and provide risk management for agriculture” by 1) completing the ongoing technical studies and engineering to facilitate temporary transfers; 2) defining and quantifying potential third-party impacts to shareholders within a ditch system engaged in a fallow program by providing funding in support of an economic study; and 3) minimizing permanent dry-up.³⁰⁸

The Arkansas Basin is working on ATM projects and others are under development. Future ATM projects will be identified using stakeholder input and current pilot project data.³⁰⁹

The Colorado BIP notes the difficulties associated with ATMs. The main obstacles for alternative transfer methods are loss of income, lost market share, and the lack of expertise in farming new crops. The plan also states that problems need to be addressed on a broad scale as they occur in each basin across the state.³¹⁰

The Gunnison BIP did not specifically identify ATMs as a method to meet its future needs. Nevertheless, the Gunnison BIP does state that the roundtable is committed to the voluntary preservation of agriculture. The measurable outcome for this goal is to preserve the current baseline of approximately 183,000 acres of protected agricultural land, and to expand participation in conservation easements by 5 percent by 2030.³¹¹

The North Platte BIP, like the Colorado and Gunnison BIPs, does not include ATMs as a means to achieve the goals and measurable outcomes of their basin. The plan does include agricultural use for the basin: "Describe and quantify the environmental and recreational benefits of agricultural use." The measurable outcome for this goal is to complete at least two new multi-purpose water projects by 2025 that meet multiple needs identified in the plan.³¹²

The Rio Grande BIP explores innovative soil health and CU reduction techniques as part of the goal to achieve groundwater sustainability. While specific water rights transfers may not be needed as part of these practices, the techniques are similar. As stated in the BIP:

The amount of water available to irrigators is projected to decrease, as discussed extensively in this Plan. As such, some producers may want to explore opportunities to reduce pumping through alternative cropping rather than drying up productive farm ground. Incorporating alternative crops and farming methods that reduce consumptive water use are opportunities to maintain an economically stable future for agricultural producers but have challenges, as equipment needs and market conditions make switching to new crops complex.

Valley producers may consider growing fewer acres of higher-value crops, such as organics. Demand for locally grown, organic food continues to rise. Assistance for growers wanted to diversify their operations, switch to organic farming altogether, or enter into grower cooperatives would be a great benefit to expanding this option. Local farmers' markets have become a major source of local foods and are now a regular summer-into-fall feature in towns throughout the Valley.

Growers can also reduce water use by incorporating green manure into their crop rotation. Green manure is a mix of crops, such as mustards, radishes, and sorghum-sudan grass, which is specifically grown to be turned into the soil. Green manures improve soil health, as discussed in Section 5.2.6: Improving Soil Health, and require less water to go than other rotational crops. While the grower would not be selling a product in these years, the improvement to their operations has been shown to pay back the investment in green manure....

There are water savings through such methods as drip irrigation that will be realized through reduced evaporation losses. In addition to more efficient water use, the subsurface irrigation system may produce a higher quality of crop with less herbicides and pesticides

required. , the widespread viability of subsurface irrigation has not yet been demonstrated in the Valley.

Improved water management techniques, such as irrigation scheduling, can also boost efficiency without reducing crop yields. Finally, such practices as deficit irrigation — giving crops just enough water to produce a minimal profit — may be a noteworthy technique for water rights holders on the cusp of receiving deliveries.³¹³

The South Platte/Metro BIP identifies successful implementation of ATMs as one of the measurable outcomes for their plan's agricultural goal.³¹⁴ The joint plan also lists minimizing traditional agricultural buy-and-dry and maximizing the use of ATMs to the extent practical as one of the eleven key elements to their plan. ATMs play a key role in the South Platte/Metro's B and C portfolios for meeting approximately 35,000 acre-feet of their future water demands.³¹⁵ Through the CWCB's Alternative Agricultural Water Transfer Methods Grant Program, the South Platte/Metro Basin has completed and is currently working on several ATM grants, and lists one of these projects as a new "IPP." The plan lists several recommendations to overcome ATM barriers associated with water court and transaction costs:

- Development of special review procedures to facilitate ATM agreements
- Adoption of presumptive CU procedures
- Determination of historical CU for a canal or ditch system
- Develop specific methodologies for measuring, calculating, and monitoring CU water transferred through ATM projects (the Arkansas Basin is developing an "Administrative Tool" to calculate a farm's historic CU and return flow obligations)
- State funding of infrastructure cost
- Pursue transfer of a portion of a water right³¹⁶

The Southwest BIP listed the implementation of ATMs as a means to preserve agriculture, while addressing other water use needs, as one of their measurable outcomes.³¹⁷

The Yampa/White BIP mentions ATMs as a process to achieve their goal to "Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within context of private property rights." Part of this goal is not only to preserve current protected agricultural acreage, but to expand it as well. The plan specifically states that a process for this goal is to "Identify projects that propose to use at-risk water rights, alternative transfer methods, water banking, and efficiency improvements that protect and encourage continued agricultural water use."³¹⁸ The plan has not identified any specific ATMs to meet this goal.³¹⁹

IBCC No-and-Low-Regrets Action Plan

The IBCC developed several ATM recommendations as part of the no-and-low-regrets action plan, as summarized in Table 6.4-2.³²⁰

Additional details regarding IBCC low and no regrets information pertaining to alternative agricultural transfer methods can be found in the latest version of IBCC No-and-Low-Regrets Action Plan.

Table 6.4-2: No-and-Low-Regrets ATM Actions

Completed and Ongoing Actions	Potential Future Actions
<ul style="list-style-type: none"> • Implement ATM Grant Program • Ongoing CWCB and IBCC support 	<ol style="list-style-type: none"> 1) Develop an Incentives Program <ol style="list-style-type: none"> a) Financial incentives b) Streamlining approval processes c) Selective and systematic considerations (encourage maintaining or increasing highly productive lands) 2) Establish ATM Demonstration Projects <ol style="list-style-type: none"> a) Overlay district or authority b) Storage and other infrastructure c) Multi-purpose objectives d) Adequate measurement and monitoring 3) Establish Basin Goals and Track Ongoing Progress 4) Implement ATM Program 5) Analyze Infrastructure Needs for Storage of ATM Water

Actions

The CWCB should consider the following list of options or action steps needed to help ensure that alternatives to permanent farmland dry-up are more attainable:

1. Monitor current and future legislation necessary for the implementation of ATMs, including enhanced sharing opportunities and system flexibility.
2. Encourage funding grants that focus on implementing on-the-ground ATM projects, data collection, flexible administration practices, ATM affordability, basin-specific ATM projects, and infrastructure modernization.
3. Support appropriate following-leasing pilot projects, such as the Catlin Canal pilot project, by responding to and processing applications in a timely manner under HB 13-1248 (C.R.S 37-60-115). These projects could be further supported through the ATM grant program. To proactively cultivate these projects, the CWCB will organize and conduct regional workshops with partners or co-sponsors to share lessons learned on actual ATM projects, and to garner additional interest by discussing program benefits.
4. The CWCB will encourage adaptive strategies that capture a “learning by doing” concept for pilot programs and other on-the-ground ATM applications.
5. Continue to provide ATM leadership as well as technical and financial support to the basin roundtables in the development of their BIPs as they relate to ATMs.
6. Assess quantitative information related to agricultural dry-up in SWSI 2016 , including lessons learned and monitoring the effects of ATMs in reducing permanent agricultural dry-up.

7. Explore financial incentives through a stakeholder process as part of the funding Section in 9.2. These incentives or grants could include the new and ongoing revenue stream or tax incentives at the local or state level.
8. The CWCB will work with the South Platte, Metro, and Arkansas Basin Roundtables to develop a WSRA or ATM grant to explore the formation of one or more pilot mutual management entities with municipal and agricultural stakeholders. The mission of the mutual management entity is to facilitate water sharing arrangements. Part of the study will determine initial start up costs necessary to reach the goal, for instance by analyzing funding levels needed to reduce the barrier of high transaction costs associated with water right transfers, making a water right more flexible, and water rights accounting uncertainties under the current water courts, legal, and administrative system.
9. The CWCB will seek to help stakeholders understand the benefits and social barriers of ATMs and how they can function under existing and future law.
10. The Colorado water community and decision makers could consider the following options in support of ATM goals:
 - Continue to monitor basin level work to explore options to develop flexibility for certain agricultural water rights to be used for multiple purposes.
 - Implement tools provided in SB 15-198 (C.R.S. 37-60-115) that broaden pilot project end uses set forth in HB 13-1248 (C.R.S. 37-60-115). Such pilot projects could demonstrate agricultural transfers that meet environmental, recreational, industrial, or compact needs in addition to urban needs. The CWCB will encourage pilot projects to test the latest concepts or meet multiple benefits.
 - Reduce barriers, such as high transaction costs associated with water right transfers and water rights accounting uncertainties through continued exploration of pilot projects and other voluntary transactions to demonstrate streamlined approached or by providing financial support.
 - After a thorough outreach and stakeholder process, consider legislation to protect existing municipal owners of transferred water rights, if they choose to go through the court process to stipulate that their permanent agricultural transfers can be operated as ATMs. This concept could help ensure that a water rights owner could fall back to their previously adopted stipulations if the water court process for an ATM option yields an unfavorable outcome.
 - Strengthen the recognition for new types of legal beneficial uses such as leased or flex use water.
 - Identify and develop a request for a multi-basin WSRA grant through the basin roundtables. The goals of a potential grant would be to compile ATM data, identify areas that will encourage irrigators to enter agreements, analyze barriers, and increase awareness of the program.
 - Research benefits and challenges of “buy and supply”, which could preserve local irrigated agriculture and associated benefits. The concept is for M&I water users to purchase irrigated lands with associated water rights, establish a conservation easement for future farming, and then supply a full amount of water for a certain

number of years out of a 10-year period. The water supply in the remaining non-farming years could then be delivered to the M&I user.

- Explore the possibility of third parties assisting with funding of ATMs to assure that farmers are appropriately compensated and that water suppliers are paying a reasonable incremental cost for firm yield. In this case, the third party would essentially assist in the effort to uphold the value of continued viable agriculture.
- Support research into the benefits and challenges of temporary rotational “idling” of crops, deficit irrigation, and split season irrigation.
- Incorporate improved water use data into decision making processes in a way that reduces uncertainty for water managers, and develop basin specific models for use in water court cases the help reduce transaction costs.

6.5 Municipal, Industrial, & Agricultural Infrastructure Projects & Methods

Colorado's Water Plan encourages the use of grassroots efforts to identify and implement projects and methods to meet community and agricultural water needs throughout Colorado and achieve the following statewide long-term goals:

- Use water efficiently to reduce overall future water needs.
- Establish a process to identify the projects and processes to meet the water supply gap for communities while balancing the needs of agriculture, the environment, and recreation across the state.
- State encouragement and assistance in the development of balanced and appropriate storage that can meet multiple benefits, including instream flow and augmentation needs.
- Meet community water needs during periods of drought.
- Develop and implement policies and strategies that support meaningful agricultural viability statewide.

Many identified projects, storage, other infrastructure, and methods, in addition to conservation, reuse, and alternative agricultural transfers are needed to meet future municipal, industrial, and agricultural needs. This section discusses the different types of projects that need to be implemented to meet Colorado's growing needs, how the basin roundtables identified these projects and methods, and what needs to be done to support them. This section also includes a discussion of the IBCC's adopted “No and Low Regrets Action Plan” as it relates to the implementation of projects and methods and a summary of ongoing initiatives relating to the viability of agriculture statewide. Agricultural viability was named as a priority in Colorado's water values, and Colorado's Water Plan includes specific policies and strategies to advance this concept.

Overview

The draft Basin Implementation Plan (BIP) process produced a compendium of projects and methods to meet Colorado's future water needs, which are the foundation of this section. In developing their respective lists of projects and methods, the basin roundtables relied upon previously developed IPPs, conducted interviews with water providers, and solicited public input to update existing IPPs and identify additional projects and methods. For the purposes of Colorado's Water Plan, the term *projects and methods* includes IPPs and additional efforts featured in the BIPs to close the M&I gaps and reduce agricultural shortages.

The basin roundtables vetted these proposed projects and methods to develop a draft list for their respective BIPs. Some roundtables vetted the preliminary list through the entire roundtable, while

others reviewed projects and methods by subcommittees. In the end, each roundtable reviewed or adopted the draft BIPs. In addition, many of the roundtables tiered or prioritized their projects and methods to assist with future implementation.

The goal of developing lists of projects and methods is to meet Colorado's future water needs. In addition, this work will help calculate the remaining M&I water supply and demand gaps; determine residual agricultural shortages; estimate the costs of implementing the proposed projects and methods; identify the potential for intra-basin and inter-basin collaboration on proposed projects and methods; and identify the interrelationship and the potential for collaboration between consumptive and nonconsumptive projects and methods.

The BIPs proposed more than 400 projects and methods. Although some of the proposed projects and methods are designated primarily as single-purpose, many are multi-purpose. The multi-purpose projects could benefit agricultural, M&I interests. Alternatively, these projects could benefit the environment or expand recreational opportunities while meeting municipal or agricultural needs. Those projects and methods that intentionally target consumptive and nonconsumptive benefits are categorized as *multi-purpose*.

The BIPs' projects and methods aim to close the M&I gaps, reduce agricultural shortages, or both, and may have financial expenditures attached. Many roundtables included implementation cost estimates, although some did not. Proposing a project or method is one component of implementation, while developing cost estimates and financing mechanisms is another. Many proposed projects and methods are well developed and currently in the permitting stages; however some are conceptual in nature, with uncertain or no stated cost estimates. The validity of cost estimates varies greatly across proposed projects and methods and across BIPs. With that caveat, individual project and method implementation costs range from \$50,000 to \$211 million. It should also be noted that some proposed projects or methods are multi-year efforts, with a wide array of implementation strategies and approaches. Identified cost estimates to implement the proposed projects and methods range from \$85 million to \$486 million per BIP, with a statewide preliminary total of approximately \$902 million. Many BIPs have not yet determined costs for their projects and most have not done so on a consistent basis. Therefore, this number represents a minimum financial need.

Another consideration for the identified projects and methods in the BIPs is their estimated yield, which affects the calculated M&I gaps and agricultural shortages. The yield is subject to some variability and further refinement by basin roundtables and through potential project permitting and financing. However, the estimated yield of the proposed projects and methods by BIP ranges from 6030 acre-feet per year of new supply to 321,316 acre-feet per year. Similarly, the range of yield reflects the level of participation of project sponsors and project beneficiaries. Some projects and methods have multiple sponsors, ranging in size from small localized water providers, to regional water providers, such as conservancy and conservation districts, or cities. Furthermore, some projects are sponsored by a single entity while the associated beneficiaries are many. In other cases, a proposed project or method is sponsored by a single entity and has only one beneficiary. The BIPs propose many combinations of project sponsors and project beneficiaries, reflecting the collaborative nature of the BIP process and the anticipated results. This section takes a more in-

depth examination of each BIP. Finally, the section discusses the IBCC's No and Low Regrets Action Plan and actions as part of Colorado's Water Plan.

New and Emerging Water-Supply Projects and Methods

As the state of Colorado and the basin roundtables move towards executing BIPs and Colorado's Water Plan, innovative and creative solutions are needed to meet future demands, given the opportunities for funding and the nature of limited water resources. There is no perfect solution, but these emerging trends add to the suite of options that the state and the basins can implement.

Aquifer Recharge

Aquifer recharge, also referred to as artificial recharge, is the process of infiltrating water to an aquifer through ponds, basins, canals, or wells.³²¹ Artificial recharge to the alluvial aquifer is most commonly used in Colorado for augmentation of stream depletions because of well pumping. Most of these alluvial recharge projects for augmentation occur in the South Platte Basin, outside of the designated groundwater basins.³²² Permanent artificial recharge projects, outside of the designated basins, must ultimately receive a decree through water court and operate within confines of Colorado's prior appropriation system. Additionally, a protocol for alluvial recharge within the South Platte Basin is available.³²³

ASR

ASR uses aquifer recharge or injection to achieve the storage of water in the aquifer during times of low demand and high water supply and later recovered by pumping when demand exceeds surface supply.³²⁴ In an alluvial aquifer, recharge for ASR is accomplished by allowing water to seep into underlying aquifer. For confined aquifers, ASR uses wells to inject the water at pressures greater than what exists in the aquifer. Colorado's Denver Basin Bedrock aquifers have been used by several water providers for the storage of water over the past several decades. The Denver Basin aquifers are confined bedrock aquifers and they are not considered tributary to the stream system. The water in these aquifers is appropriated under a separate legal framework based on overlying land ownership. Additionally, ASR projects utilizing these Denver Basin aquifers are governed by specific rules. Although the majority of ASR projects use the Denver Basin aquifers, there are also two ongoing ASR projects in Colorado that involve the use of alluvial aquifers: Aurora's Prairie Waters project in the South Platte basin; and Cherokee Metropolitan District's aquifer replacement plan in the Upper Black Squirrel basin.

Collaborative Management Solutions

These sort of projects and methods frequently cross basin boundaries, and consist of multiple parties working together to achieve often disparate goals. Several examples of these solutions are found in Section 9.2, where entities representing many uses come together for creative water management. Examples include the CRCA, the Arkansas River Voluntary Flow Agreement, and the WISE Partnership. In these solutions, a host of different needs can be met by creative collaboration and the involvement of many stakeholders throughout the entire agreement process.

ATMs

For much of Colorado's water history, the agricultural water user has been faced with two options: continue operations as normal, or sell water rights to an interested party, often a municipality seeking to firm up supply. Under potential alternatives to agricultural transfer, interested parties seek to provide a third option, within the boundaries of Colorado's prior appropriation system.

Though the viability of certain types of alternative transfers are still under review, this option should be a manner by which Colorado seeks to meet future needs, as opposed to the permanent "buy and dry" of agricultural lands. ATMs are discussed in more detail in Section 6.4.

BIP Identified Municipal, Industrial, and Agricultural Infrastructure Projects and Methods

The types of projects and methods that could potentially be implemented are as varied as the needs in each basin and statewide. While projects and methods generally fall into two generic categories (structural and non-structural), this overview of the BIPs warrants a more specific categorization. In these summaries, projects will be tallied by type and use identified in the BIP, even though many projects may have multiple benefits.

SWSI 2010 identified several categories of IPPs, which have been consolidated into the following:

- Agricultural water transfers (including ATMs)
- Reuse of existing fully consumable supplies
- Growth into existing supplies
- In-basin projects
- New transbasin projects³²⁵

The majority of the projects identified in the BIPs fall into the category of "In-Basin Projects." For the purposes of this summary, in-basin projects could align with the following descriptions:

- Collaborative Management
- Storage Improvements & Expansion
- New Storage
- Ditch & Diversion Improvements
- Monitoring, Assessment, and Planning Efforts
- Municipal Infrastructure
- Energy
- ASR
- Water Rights and Supply
- Multi-purpose

This section examines the "primary message" of each BIP, summarizing the prioritized projects and how the projects or methods align with basin goals and measurable outcomes. This section also describes the process each basin used to garner public input, demonstrating how basins generated project lists. Finally, this section describes highlights of the projects and methods and identifies the acre-feet of development and costs when available.

In the basin summaries, project costs and associated identified acre-feet come from material provided in the BIPs. Each basin conducted outreach and assimilated and evaluated projects in a manner unique to the respective basin. As the basin roundtables further refine the BIPs and projects and methods move to implementation, project information, costs, and associated acre-feet will become more defined.

Arkansas Basin

Primary message: The basin roundtable identified additional storage as a primary goal of the implementation plan. Roundtable members believe that traditional storage is the best avenue to meet the basin's supply needs, for both consumptive uses, as well as environmental and recreational. Additional methods the basin roundtable identified include ASR projects, as well as alternatives to ATMs. Moving forward, the roundtable plans to focus efforts on a disaggregation of the basin gaps to identify more localized needs at the county level. The roundtable will also take a closer look at identified projects and methods, to prioritize available funding and resources. In project implementation, the roundtable identified compact compliance issues as a key challenge, with a critical gap also represented by the replacement of nonrenewable groundwater, and sustainability of designated basins.³²⁶

Process: The roundtable reviewed the SWSI 2010 IPP list, and held 17 public outreach meetings where more than 100 Input Forms were submitted.³²⁷ These forms proposed projects, methods, and potential policy implementation. The roundtable will review and rank these input forms, with some proponents invited to attend roundtable meetings and present on the identified project, method, or suggestion. As part of the roundtable's organization of basin needs, projects, and methods, they created a comprehensive database. The roundtable categorized projects that met a basin need as follows within the database:

Arkansas Basin at a Glance

120 projects identified on the IPP List which meet municipal, industrial, or agricultural needs

\$84,700,000 in costs identified for **2** projects

166,500 acre-feet of development identified for **17** projects

- All Input List: all identified needs from all sources.
- Preliminary Needs List: filtered to remove complete or obsolete needs.
- Master Needs List: The provider of each need on the Preliminary Needs List was asked to identify a Solution and a Plan of Action to implement a solution for the identified need. All needs with a defined Solution and Plan of Action carried forward onto the Master Needs List. Projects on the Master Needs List were located by latitude and longitude for later mapping.
- IPP List: Needs on the Master Needs List were compared to the criteria for an IPP per the SWSI 2016 draft glossary. Needs on the Master Needs List that met the SWSI 2016 IPP criteria are included in the IPP List.

While projects and methods included in the All Input List may include obsolete or completed projects, the IPP list is designed to meet SWSI criteria for an IPP.

Projects and methods summary: The roundtable identified a total of 120 projects and methods on the IPP List that meet municipal, industrial, or agricultural needs.³²⁸ 17 of these projects identify acre-feet, totaling 166,500 acre-feet of development.

Colorado Basin

Primary message: The Colorado Basin Roundtable is focused on completing a basin-wide stream management plan, with more in-depth analysis and understanding of the amounts of water necessary to maintain environmental and recreational attributes. The basin roundtable expressed concern about the uncertainty regarding the ability of current water supplies to meet in-basin consumptive use, as well as environmental and recreational needs, for future projects and methods. The basin emphasized the need for more in-depth studies and work on the effects of climate change on water supplies and the variability of wet and dry years. The roundtable stated: “the most prudent planning approach... is to assume that there is no more water to develop for export from the Colorado Basin.”³²⁹ The extensive public outreach undertaken by the basin, as described below, resulted in a comprehensive list of potential identified projects and methods, which make up a suite of options for the basin to meet their future needs.

Process: The roundtable members divided into Project Leadership Teams (PLTs), which focused on particular subject matter areas within the BIP. The consumptive PLT worked to identify projects within the basin that would meet future water supply needs. The PLT interviewed water providers throughout the basin, in person or through a standardized questionnaire. These information gathering efforts focused on existing and forecasted supply, as well as projects and methods to meet demands. Existing studies or reports were also analyzed for planned projects. The basin held town hall meetings and roundtable members and consultants traveled to many meetings, such as county commissions and city councils, to gather information. Roundtable members took a closer look at the list of projects and methods, and then identified representative projects in each subregion of the basin that met basin themes and subregion goals. These projects were designated “Top Projects” and represent important needs both at the basin-wide and subregion level.

Colorado Basin at a Glance

28 projects identified as Top Projects which meet municipal, industrial, or agricultural needs

\$135,000,000 in costs identified for **13** projects

21,472 acre-feet of development identified for **3** projects

Projects and methods summary: The roundtable identified a total of five basin-wide Top Projects and methods.³³⁰ Twenty-six Top Projects were identified by subregion. All 26 subregion projects were identified as multi-purpose. Beyond the identified Top Projects, additional projects and methods submitted through the public input and targeted technical outreach are listed in the BIP Exhibits.

Basin Top Projects were evaluated by Basin Goals:

- 21 Top Projects were identified that meet the basin goal of “Sustain Agriculture.”
- 23 Top Projects were identified that meet the basin goal of “Secure Safe Drinking Water.”³³¹

Future efforts of the basin will focus on implementation of identified projects and methods, with modeling efforts underway to further understand potential constraints and opportunities within the river system.

Gunnison Basin

Primary message: The primary goal of the Gunnison Basin is to “Protect existing uses in the Gunnison Basin.”³³² With that overarching goal in mind, other goals promote the continued importance of agriculture, the protection of environmental and recreational uses, and the maintenance of infrastructure within the basin. Agricultural shortages and methods to deal with this need are a primary focus, as projects and methods are identified and prioritized with this goal in mind. M&I needs, as quantified in the BIP, are expected to be met with currently existing supplies, and the implementation of currently planned projects and methods. Projects and potential constraints were modeled in the BIP, to evaluate the potential effects on supply and water rights from project or method implementation. This modeling effort provided a cursory feasibility analysis for projects at a basin-wide scale, taking into account water availability, irrigation decrees, agricultural effects on streamflows, and instream flows. Projects and methods identified in the basin were evaluated and put into tiers by the roundtable.

Gunnison Basin at a Glance

45 projects identified on the Tier 1 list which meet municipal, industrial, or agricultural needs

\$478,107,269 in costs identified for **33** projects

139,406 acre-feet of development identified for **21** projects

Process: The roundtable members and consultants conducted a series of targeted technical outreach meetings throughout the basin, working with water management agencies and stakeholders to identify projects and methods intended to meet future needs within the basin. A list of current projects was created, intended to represent the state of water planning at the time of BIP publication. Projects identified through the outreach process were compared to the Basin Goals, and evaluated by their timeline for completion. With these two criteria in mind, the BIP committee approved three “tiers” of identified projects and methods:

- **Tier 1:** implementation likely feasible by 2025; project does excellent job of meeting Basin Goals.
- **Tier 2:** implementation likely not feasible by 2025; project would excel at meeting Basin Goals. Project may also have important conditional water rights and/or completed planning efforts.
- **Tier 3:** implementation likely not feasible by 2025; project in preliminary stages of planning and/or may meet Basin Goals to lesser degree.³³³

Modeling analyses also informed the tiering process, identifying projects and methods with multi-purpose uses, as well as the selection of agricultural projects that most effectively address shortages. As stated, the project list is intended to be a “snapshot” of current planning efforts, and future updates and additions to the BIP may affect the current prioritization or update information on projects and methods.³³⁴ Future studies may also affect the prioritization, as supplies, demands, or processes are updated and refined.

Projects that were classified as Tier 1 were analyzed in “Project Summary Sheets” created by the roundtable. These sheets provide a more in-depth look at the projects and methods, with information such as project yield, sponsor, and a detailed look at how the project meets basin goals. Projects that were classified as Tiers 2 or 3 were briefly outlined in a table, as well as inventory projects, which will further examine regional projects and methods.

Projects and methods summary: The roundtable identified a total of 45 Tier 1 projects and methods meeting municipal, industrial, or agricultural needs.³³⁵ Tier 1 projects were rated by their ability to meet Basin Goals:

- All 49 Tier 1 projects meet the overarching basin goal of “Protect existing water uses in the Gunnison Basin.”
- 40 projects and methods seek to specifically “Improve agricultural water supplies to reduce shortages.”
- 9 projects meet the basin goal of “Identify and address municipal and industrial water shortages.”³³⁶

A great number of the Gunnison roundtable’s identified projects have an agricultural benefit, as expected in this largely agricultural area.

North Platte Basin

Primary message: The Basin Goals established by the North Platte Basin Roundtable are intended to maintain historical water uses within the basin, as well as provide a look forward at the future of development. Chief concerns in this particular basin are the Equitable Apportionment decree and the depletion allowance of the Three State Agreement.³³⁷ Agricultural needs related to shortages are paramount, as well as infrastructural storage and water delivery concerns. A list of “potential basin solutions” was created, including both structural projects and methods for water management.

Process: Similar to the Gunnison Basin roundtable, the North Platte process was driven by identification of projects, and comparing those projects to Basin Goals. Targeted technical outreach was conducted by the roundtable, reaching out to water managers and other stakeholders. Modeling analyses were performed within the basin to identify challenges to implementation and examine the effects of specific projects. As projects were reviewed, potential multiple use projects were highlighted, and potential water availability constraints were called out. With the basin roundtable focus on agricultural needs, a shortage analysis was conducted to identify projects and methods that most effectively addressed shortages.

The list of solutions was prioritized by conformity with the Basin Goals, as well as timeline for potential implementation. Some projects were selected to receive additional analysis in the form of a project summary sheet, for these reasons:

North Platte Basin at a Glance

52 total projects identified which meet municipal, industrial, or agricultural needs.

14 projects analyzed in summary sheets

12,197 acres of new irrigation for **9** projects

11,993 acre-feet of development identified for **5** projects

- The project, and associated analysis herein, is representative of other projects on the list, such as the case with the Proposed Willow Creek Reservoir and the Hanson and Wattenberg Ditch Acreage;
- Implementation of the project is currently being pursued, such as the case with the Protocols and MacFarlane Reservoir; or
- Implementation of the project is potentially more feasible than projects on the following list because of limited constraints or challenges or more support from the Basin Roundtable, as with the Canal Maintenance and Improvements project.³³⁸

The project summary sheets provide a more extensive analysis of project or method information, such as “project constraints, implementation strategies and how well the project meets the Basin Goals.”³³⁹

Projects and methods summary: The roundtable identified a total of 52 projects and methods meeting municipal, industrial, or agricultural needs.³⁴⁰ The 14 projects that received additional analysis were compared with the basin goals:

- 13 projects met the basin goal to “Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.”
- 7 projects specifically addressed the basin goal to “Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.”
- 3 projects met the basin goal to “Increase economic development and diversification through strategic water use and development.”³⁴¹

The majority of the projects and methods identified serve an agricultural benefit. The most numerous projects are agricultural improvements, and many of the new storage projects will need further study to refine acre-feet projections.

Rio Grande Basin

Primary message: The Rio Grande Basin Roundtable identified 14 different goals, with central tenets of “a resilient agricultural economy, watershed and ecosystem health, sustainable groundwater resources, the encouragement of projects with multiple benefits, and the preservation of recreational activities.”³⁴² Additionally, the preservation of the agricultural economy, which represents 99 percent of the basin’s water use, is identified as an overarching goal. Through public outreach and the work of roundtable subcommittees, projects were identified that met Basin Goals. Projects and methods that meet multiple benefits and uses were identified as desirable, and would stand a greater chance of receiving funding. In future planning efforts, the roundtable plans to develop project ranking criteria, and continue to identify projects and methods that meet Basin Goals.

Rio Grande Basin at a Glance

61 projects identified which meet municipal, industrial, or agricultural needs

\$129,754,895 in costs identified for **29** projects

6,030 acre-feet of development identified for **2** projects

Process: Through the subcommittee and stakeholder outreach process, 29 projects were identified that the roundtable chose for a more in-depth analysis through project fact sheets.³⁴³ These fact

sheets provided more information about each project, such as sponsor, location, estimated project costs, and the comparison of the project outcomes with Basin Goals. A matrix was also generated that displayed each project, the needs met by the project, and which basin goals would be met through project implementation. 25 of these projects were site-specific, and cost estimates were provided through the year 2020.³⁴⁴

21 additional projects and methods were identified by the roundtable for future consideration and discussion. These projects were not analyzed at the fact sheet level because of time constraints and available information, but the roundtable believes that they could be beneficial to meeting basin needs and Goals. The basin intends for this plan to remain dynamic, with projects and methods added as additional needs, methodologies, and focus areas are identified.

Projects and methods summary: The roundtable identified a total of 61 projects and methods meeting municipal, industrial, or agricultural needs.³⁴⁵ Projects and methods were evaluated by their ability to meet Basin Goals. Within the 29 projects evaluated by Fact Sheets:

- 14 projects meet the goal of “Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin’s long-term water needs, including storage.”
- 14 projects and methods seek to “Manage water use to sustain optimal agricultural economy throughout the Basin’s communities.”
- 24 projects and methods are identified as multi-purpose, meeting the basin goal to “Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.”

South Platte Basin (Including Metro)

Primary message: The South Platte and Metro Basin roundtables worked together on a joint BIP, and sought for water supply solutions to be “pragmatic, balanced, and consistent with Colorado water law and property rights.”³⁴⁶ Multi-purpose projects are emphasized, with the following three objectives specifically identified. “Projects and methods should be configured to meet multi-purpose objectives that balance:

- a) Consumptive with environmental and recreational needs;
- b) Surface and groundwater utilization and storage; and
- c) Current versus potential future needs and values.”³⁴⁷

South Platte / Metro Basins at a Glance:

63 projects identified which meet municipal, industrial, or agricultural needs

191,980 acre-feet of development identified for **23** projects

This BIP specifically referenced the “Four Legs of the Stool”, a result of the IBCC’s work that identifies four key tactics for meeting future water supply.

The South Platte/Metro BIP identifies three categories of water development to meet future uses within the basin: 1) Water use efficiency improvements and water sharing strategies including conservation, reuse, ATMs and system integration; 2) Supply development involving new storage and conveyance systems and investigating, preserving, and developing Colorado River options; and 3) Watershed health and water quality management.³⁴⁸ The BIP examines both larger scale concepts, such as TMDs, and smaller scale projects and methods, such as storage and reuse projects. Project concepts identified in the joint BIP are primarily geared toward meeting municipal,

industrial, and agricultural needs. These concepts are further divided into project categories such as reuse, agricultural transfers, ASR, and TMDs.

Process: Like some other basins, the South Platte/Metro joint effort began with the IPP list identified through the SWSI 2010 process. Potential project sponsors (water conservancy districts, municipalities, counties) were interviewed via project summary sheets, gathering basin project information such as sponsor and estimated cost. Project summary sheets that were gathered through the outreach process were reviewed by the Executive Committee of the Metro roundtable, and the South Platte's Rio Chato Committee. For inclusion in the BIP, projects or methods were then reviewed by both roundtables in full. Additionally, the roundtables considered three conceptual projects, intended to demonstrate a collaborative approach to meeting basin needs moving forward.

Projects and methods summary: The basin roundtables identified a total of 63 projects and methods meeting municipal, industrial, or agricultural needs.³⁴⁹

- 13 projects identified as Reuse IPPs
- 8 Agricultural Transfer IPPs
- 17 In-Basin IPPs
- 5 Transbasin IPPs

Southwest Basin

Primary message: The Southwest Basin takes the approach that all needs should be viewed equally, be they agricultural, municipal, industrial, environmental, or recreational. 21 goals and 31 measurable outcomes were adopted by the roundtable in their BIP, with water supply needs as the focus.³⁵⁰ Since SWSI 2010, the roundtable has identified the completion of 55 projects within the basin. Through the basin's outreach process, conducted in support of the BIP, more than 80 new projects were added to the list, totaling 164 IPPs. Of these identified projects and methods, "agricultural IPPs make up about 19 percent of the total IPPs on the list to date. Municipal and industrial IPPs make up about 29 percent of the total IPPs on the list to date."³⁵¹ The BIP is intended to serve as a living guidance document for basin water supply planning, with projects, methods, and goals continuing to be refined as needs evolve.

Southwest Basin at a Glance:

117 projects identified which meet municipal, industrial, or agricultural needs

\$60,000,000 in costs identified for 1 project

30,354 acre-feet of development identified for 8 projects

Process: Themes, goals, and measurable outcomes identified by the basin are geared towards identifying and meeting water supply gaps. Themes B and C directly address the matter: "B) Maintain Agriculture Water Needs, C) Meet M&I Water Needs."³⁵² With these overarching themes in mind, the roundtable conducted outreach across the basin, contacting water managers and other stakeholders to identify potential new projects and methods that had arisen since SWSI 2010. Public workshops were also conducted by roundtable members and consultants, to inform the public about the BIP and Colorado's Water Plan process, and to elicit information about potential projects or methods. The listing of projects in the BIP began with the SWSI 2010 identified projects, and then roundtable members and consultants contacted potential project proponents, gathering

project and methods information in the form of a questionnaire. Project questionnaires were vetted by the roundtable, and projects or methods were adopted by inclusion in the BIP.

Projects and methods summary: The roundtable identified a total of 117 projects and methods meeting municipal, industrial, or agricultural needs.³⁵³ The BIP highlights some specific IPPs that meet Basin Goals and Measurable Outcomes, and demonstrate the types of projects and methods planned within the basin:

- 8 multi-purpose, cooperative, and regional projects and processes such as renewable energy partnerships, water conservation and management plans, and optimization studies
- 5 potential IPPs related to hydropower
- 7 agricultural infrastructure improvements

The Southwest Basin Roundtable will continue to evaluate projects and methods, and refinement of project information will provide more detail on cost estimates and new acre-feet.

Yampa/White/Green Basin

Primary message: In the Yampa/White/Green BIP, the roundtable focused on two main concepts, regarding implementation of projects and methods for municipal, industrial, and agricultural uses. First, the roundtable seeks to provide sufficient supply of “local water resources for existing uses and future development.”³⁵⁴ Also identified was the need for implementation of projects and methods that are “appropriately located, sized, and operated...to protect important water uses and the environment.”³⁵⁵ The roundtable also discusses the importance of the Colorado River Compact, and the need to keep compact concerns in mind when planning for the implementation of projects and methods. With these overarching themes in mind, the roundtable adopted eight primary basin goals, with meeting existing and anticipated future uses within the basin as the chief concern.

Yampa/White/Green Basin at a Glance

27 projects identified which meet municipal, industrial, or agricultural needs

\$4,950,000 in costs identified for **3** projects

317,316 acre-feet of development identified for **12** projects

A list of Projects and Processes was developed by the roundtable, in consultation with basin water managers and other stakeholders. The list is intended to remain dynamic; to be updated as basin needs, the understanding of river operations, and potential project proponents may be updated and refined. The Projects and Processes identified stem from information provided through basin studies, such as SWSI 2020, and the 2014 Project and Method Study funded by the roundtable. Twenty-one projects were identified by the roundtable as meeting basin goals, and appropriate for implementation. The majority of the projects identified are new storage projects, with municipal, industrial, and agricultural needs being met by implementation.

Process: The roundtable undertook a public outreach process throughout the basin, to engage stakeholders and gather input on the BIP, as well as Colorado's Water Plan. Projects and Processes identified through SWSI 2010 were updated, and the most up-to-date project information was identified in the 2014 P&M Study.³⁵⁶ With the basin goals in mind, the roundtable gathered information from project proponents and stakeholders. Surveys distributed throughout the basin at

public information meetings or through individual contact by members of the BIP Committee were intended to identify projects that were not included in SWSI or the P&M Study.

Projects and methods summary: The BIP identified a total of 27 projects and methods meeting municipal, industrial, or agricultural needs.³⁵⁷ Some representative projects and methods presented in the BIP are as follows:

- 9 projects identifying potential new storage sites
- 2 irrigation improvement projects
- 2 reservoir improvements or expansion

Ongoing studies in the basin will inform additional acre-feet yield, and project costs can be fleshed out by project proponents during the permitting and financing stages.

IBCC no-and-low-regrets actions

In 2014, the IBCC developed the “No and Low Regrets Action Plan” to have a high success rate for Identified Projects and Processes and implement and assess storage and other infrastructure. These strategies outline what minimum level of efforts should be carried out statewide on these topics.

Table 6.5-1 explores potential future actions agreed upon by the IBCC to develop a high success rate for Identified Projects and Processes. Statewide, the No and Low Regrets indicates that on average 80 percent of the yield identified in these projects needs to be implemented. This is equivalent to 350,000 acre-feet. Many of the IBCC's requests are underway through the BIP and Colorado's Water Plan processes.

The IBCC defined storage and other infrastructure as a critical cross-cutting topic. Storage can help water users maximize supplies by re-timing water availability. This allows users to capitalize on average and wet years and may increase the possibility of sharing water resources when possible. Storage and infrastructure are also important for minimizing agricultural losses, maximizing the use of conservation and reuse savings, and allowing for additional new supplies. In addition, storage can play a critical role in supporting the environment, particularly in support of endangered and threatened species recovery programs. Moreover, storage is an important element in protecting Colorado's interstate water rights pursuant to its compacts and equitable apportionment decrees. As Colorado plans for its water future and looks ahead to a projected 2050 supply gap, new storage and infrastructure will be needed to share, transfer, store, and convey water for the benefit of all. Additionally, new opportunities for existing storage and infrastructure should be explored to provide maximum utilization for all purposes and ensure compact compliance.

While this section discusses new storage, it is not meant to include storage that would increase transbasin diversions. Therefore, concerns related to new supply development are not included here.

Table 6.5-1: No and Low Regrets Action Plan Summary to Have a High Success Rate for Identified Projects and Processes

Completed, Existing, and Ongoing Actions	Potential Future Actions
<ul style="list-style-type: none"> • Make policy recommendations in support of IPP implementation through the 2010 "Letter to the Governors" • Establish the Collaborative Approach to Water Supply Permit Evaluation group to improve communication among state and federal agencies about permitting issues • Support key IPPs (e.g., the Chatfield Reallocation Project; WISE; the CRCA) • Coordinate the DNR's responses to IPPs through the DNR Executive Director's Office • Provide technical and financial support to project proponents through WSRA grants 	<ol style="list-style-type: none"> 1) Support Local Implementation of IPPs <ol style="list-style-type: none"> a) Provide technical and financial support, including facilitation, to BIPs b) Support the conversion of single-purpose IPPs into multi-purpose IPPs when requested by a project proponent c) Streamline state permitting processes for IPPs that meet values of the CWP d) Continue state coordination with the federal permitting entities e) Encourage cooperative projects through BIPs f) Support local permitting authorities to identify, as requested, multi-purpose components up front in project planning to incorporate county and local concerns 2) Update Tracking and Data Collection via the Basin Needs Decision Support System <ol style="list-style-type: none"> a) Support basin roundtables in providing updated IPP data as part of their BIPs b) Track and analyze effects of IPPs on the projected water supply gap 3) Optimize Funding Sources for IPPs <ol style="list-style-type: none"> a) Assess funding needs b) Target existing funding sources towards IPPs c) Identify new funding sources for IPPs 4) Generate Political Support for IPPs <ol style="list-style-type: none"> a) Facilitate and encourage regular, active communication about IPPs between the CWCB, the IBCC, and the basin roundtables b) Upon request of a project proponent, convene a facilitated dialogue among stakeholders, project proponents, and state agency representatives if there is disagreement about a proposed project or process c) Conduct outreach and education about IPPs and the state water planning process d) Develop an approach for determining whether a project meets the values of the CWP and has broad stakeholder support e) Upon request of a project proponent, encourage legislative resolutions in support of IPPs that meet the values of the CWP f) Publicly advocate for IPPs that meet the values of the CWP and have stakeholder support

Agricultural Viability

Governor Hickenlooper's executive order directed the CWCB to incorporate "a productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry" as the key values that Colorado's Water Plan is intended to reflect.³⁵⁸ In every BIP, the roundtables identified the importance of agriculture as an economic driver and overall community benefit to the basin landscapes. In discussing agricultural viability, the path forward is complicated; hydrology, commodity prices, and federal programming dictate to some extent the landscape for farmers and ranchers. The basin roundtables proposed solutions, stakeholders submitted comments to the CWCB, and the IBCC convened a subcommittee with the express purpose of exploring policies and concepts with the goal of maintaining viable agriculture in the face of future water supply and demand challenges. These initiatives are summarized, with the acknowledgement that this is an ongoing matter, with greater study, collaboration, and action items necessary moving forward.

Table 6.5-2: No-and-Low-Regrets-Action Plan Summary to Implement and Assess Storage and Other Infrastructure

Completed and Ongoing Actions	Potential Future Actions
<ul style="list-style-type: none"> Identify needed storage 	<ol style="list-style-type: none"> Manage and Develop Strategic Storage and Infrastructure <ol style="list-style-type: none"> Identify storage and other infrastructure opportunities through BIPs Manage and improve storage and infrastructure to effectively use conserved water Prepare for uncertainty in hydrology and climate change Explore and implement ASR Explore and implement storage and other infrastructure to support meeting Colorado's compact obligations Identify and Prioritize Multi-purpose Storage and Infrastructure Opportunities <ol style="list-style-type: none"> Manage and improve storage, infrastructure, and reservoir operations to benefit environmental and recreational values Support basin roundtables in identifying feasible multi-purpose projects Prioritize implementation of multi-purpose projects that meet values of the Colorado Water Plan Identify partners for permitting, funding, and constructing multi-purpose projects Manage and improve storage, infrastructure, and reservoir operations to benefit agriculture Manage and improve storage, infrastructure, and reservoir operations to benefit M&I uses Manage and improve storage, infrastructure, and reservoir operations to support hydropower production Analyze Infrastructure Needs for Storage of ATM water <ol style="list-style-type: none"> Analyze existing storage and infrastructure for opportunities to increase exchange capacity Develop water quality treatment infrastructure Manage and improve agricultural storage and infrastructure, including support of single-purpose projects as needed

Arkansas Basin

The Arkansas Basin Roundtable proposes an economic measure of agricultural benefit in their BIP. Members of the roundtable worked with a team from Colorado State University, establishing a baseline for agricultural production within the basin at \$1.5 billion annually.³⁵⁹ Given the constraints of water management within the Arkansas Basin, including the Arkansas River Compact, the roundtable seeks to maintain or increase this baseline through identifying and implementing sources of augmentation water, supporting the development of leasing/fallowing programming within the basin, and further exploring the nexus between agricultural and environmental and recreational uses.³⁶⁰

"The preservation of irrigated agriculture in the Arkansas Basin shall be given a high priority in the state water plan. It is too important to tourism, the preservation of food production, recreation, the environment and the health and well-being of our citizens as well as the economy of the State of Colorado to be ignored"

- Arkansas BIP

Colorado Basin

In assessing the future of agriculture in the Colorado Basin, the roundtable first articulates concern regarding development of a new transmountain diversion from the Colorado mainstem, citing existing diversions and the effect that further development could have on the agricultural economy.³⁶¹ The roundtable goes on to prioritize agriculture in one of six basin themes, established to be the guiding principles for the Colorado BIP: "Sustain, Protect, and Promote Agriculture." The

BIP cites the importance of return flows to other economic drivers in the basin, such as recreation and tourism, and calls out the 100,000 acre-feet in shortages estimated by SWSI 2010.³⁶² The roundtable goes on to identify four goals to support this basin theme:

- Reduce agricultural water shortages
- Minimize potential for transfer of agricultural water rights to municipal uses (within private property rights)
- Develop incentives to support agricultural production
- Increase education among the agricultural community about Colorado River Basin water issues

The BIP articulates in greater detail measureable outcomes, short-term needs, long-term needs, and projects and methods in support of each goal.³⁶³

Gunnison Basin

Under the umbrella goal of “Protect existing water uses in the Gunnison Basin,” the Gunnison roundtable also identified three basin goals centered on agricultural viability:

- Discourage the conversion of productive agricultural land to all other uses within the context of private property rights.
- Improve agricultural water rights to reduce shortages.
- Describe and encourage the beneficial relationship between agricultural and environmental recreational water uses.

“Traditional agricultural water uses not only provide direct economic benefits but also help to drive the recreational economy by preserving the beautiful landscape enjoyed by the Basin’s inhabitants and visitors.”

- *Gunnison BIP*

In the inventory of projects and methods, the Gunnison Roundtable identifies projects that seek to advance these three basin goals specifically.³⁶⁴ The roundtable discusses each goal in detail, proposes a process to achieve each goal, and defines a measurable outcome that often includes a quantifiable target. For example, in discussion of the first bulleted basin goal, the roundtable hopes to achieve the following measurable outcome: “Preserve the current baseline of about 183,000 protected acres in the Gunnison Basin and expand the participation in conservation easements by five percent by 2030 through programs like the Gunnison Ranchland Conservation Legacy.”³⁶⁵ The roundtable also includes implementation goals, which may be a number of projects to be developed by a certain benchmark, or the completion of a study to assess infrastructural needs. Specific processes and measurable outcomes are explored further in the BIP.

North Platte Basin

The North Platte Basin Roundtable identifies agricultural shortages and issues with infrastructure as priority needs in the BIP, along with concerns regarding long-term implications of the Equitable Apportionment Decree.³⁶⁶ Similar to the Gunnison BIP, one basin goal in the North Platte seeks to “describe and quantify the nonconsumptive benefits of agricultural use.”³⁶⁷ Moving forward, the roundtable hopes to complete further study of this relationship, quantifying these benefits and their overall effect on water management within the basin. Measurably, the roundtable seeks to complete

at least two multi-purpose projects in the basin meeting multiple needs.³⁶⁸ Four specific projects were identified in the BIP directly addressing this multi-purpose projects goal.

The roundtable also describes the shortages in the basin and the causes for these shortages, which fall into three categories: physical, legal, and irrigation practice related.³⁶⁹ Other basin goals seek to resolve identified issues with water availability under the decree and address issues with aging or non-functional infrastructure. Detailed project information is available for projects that address agricultural needs or multi-purpose benefits.

Rio Grande Basin

The Rio Grande BIP begins by recognizing the importance of agriculture to the basin economy, where approximately 99 percent of water is used for agriculture.³⁷⁰ The challenges inherent in compliance with the Rio Grande Compact and the Well Rules and Regulations for the basin make viability of agricultural production a major concern for basin stakeholders. Twelve of the 14 basin goals include an agricultural consideration, ranging from compliance with legal mechanisms to optimal management of agricultural and environmental water uses.³⁷¹

The BIP discusses the role of innovations in agriculture, examining the future roles of strategic crop development and irrigation improvements as potential water-management strategies.³⁷² Additionally, the BIP includes a summary of current approaches within the basin to improve soil health as a component of improved water management as it relates to agricultural production.³⁷³ The roundtable took a closer look at 29 projects and methods identified to meet future needs within the basin, 24 of which meet identified agricultural needs.³⁷⁴ Beyond the projects and methods explored in further detail through project sheets, 18 additional projects and methods were identified with an agricultural nexus, ranging from specific improvements to agricultural infrastructure to an “Alternative Cropping Education and Promotion Program.”³⁷⁵

South Platte Basin (including Metro)

In proposing strategies to meet the projected water supply gap in the South Platte and Metro Basins, the roundtables set guidelines recognizing the importance of agriculture to the basin economy, and encouraging multipurpose projects with a minimal impact on agricultural uses.³⁷⁶ In planning for the future of water within the basin, the roundtable set a basin goal to “Minimize traditional agricultural “buy and dry” and maximize use of ATMs to extent practical and reliable.”³⁷⁷ Specific recommendations for achieving this goal include further support of water sharing methods and improvements to the water court process, with an acknowledgement of the importance of vested rights to water rights holder.

“The importance of agricultural production in the South Platte and Republican River Basins should not be overlooked. It is a major factor in the State’s economy and includes processing of food and livestock from the entire state.

- *South Platte BIP*

The BIP discusses the benefits and challenges associated with the implementation of ATM projects, and it identifies some of the lessons learned from previous and ongoing ATM projects within the basin. The roundtables also provide some strategies at the local level to minimize agricultural dry-up, such as switching to cool weather crops, deficit irrigation, and dry year leasing. The BIP

emphasizes continuation of state pilot programs for water sharing, as well as collaborative solutions such as coupling agricultural easements with municipal lease options.³⁷⁸

Southwest Basin

Similar to other western slope basins, the Southwest Basin expresses concern about the Colorado River Compact, and the impact that future development of Colorado River supplies may have on basin agriculture, given downstream obligations. To that end, the roundtable proposes that proponents of a new transmountain diversion, or water providers utilizing agricultural dry-up to meet demands, should meet a 70:30 ratio of inside to outside use of municipal water by 2030.³⁷⁹ In assembling the BIP, the roundtable identified 21 goals, three of which specifically address the theme of “Meet Agricultural Needs.”³⁸⁰ In addition to the proposed municipal use ratio, the roundtable recommends implementation of ATM and efficiency projects, strategies to discourage permanent dry-up, and the implementation of at least 10 agricultural water efficiency projects identified as IPPs by 2050.³⁸¹

The Southwest BIP also surveys the challenges inherent in achieving these measurable outcomes, such as the potential opposition to a statewide conservation ratio, and the difficulties in ATM implementation under water rights administration within the basin.³⁸² In compiling the Southwest BIP, extensive outreach was conducted to update the roundtable’s IPP list. Of the total IPPs listed, agricultural projects and methods total about 19 percent of the list, while 17 percent are multipurpose and may have an agricultural component.³⁸³

Yampa/White/Green Basin

The Yampa/White/Green Basin Roundtable identified eight goals, two of which specifically mention agricultural uses of water:

- Protect and encourage agricultural uses of water in the Yampa/White/Green Basin within the context of private property rights.
- Improve agricultural water supplies to increase irrigated land and reduce shortages.³⁸⁴

In looking to the future of the basin, the roundtable undertook a modeling exercise, which demonstrated agricultural shortages under a Baseline Scenario, as well as substantial shortages under a Dry Future Scenario.³⁸⁵ The roundtable projects the addition of up to 14,805 irrigated acres within the basin, so identifying the timing and location of shortages is a priority for roundtable members. In the context of private property rights, the BIP proposes potential cooperative programs to reduce shortages, while encouraging multi-purpose projects with a benefit to agricultural uses.³⁸⁶ With this closer study of shortages, and the encouragement of policies and programming to benefit agriculture, the roundtable has identified some quantifiable outcomes:

- Preserve the current baseline of approximately 119,000 irrigated acres and expand by 12 percent by 2030.
- Reduce agricultural shortages basin-wide by 10 percent by the year 2030.³⁸⁷

Additionally, the roundtable identifies several processes related to improving agricultural infrastructure, through collaborative processes and more in-depth analysis of potential for improvements given effects on other water uses.

BIPs & Agriculture Summary

The BIPs represent the best accounting of projects and methods with the goal of agricultural viability, established and inventoried at the grassroots level, with policy suggestions coming from the stakeholders who are actively involved at their local basin levels. These local stakeholders, water managers, and water users know what sorts of practices are actionable and that will work in their area. Moving beyond an acknowledgement of the importance of agriculture to the economy and communities, the BIPs make a series of bold steps towards actionable and measurable strategies that seek to maintain the viability of agriculture in the various basins. The next section summarizes the work going on at the IBCC level, in an effort to identify policies and strategies that have statewide applicability. These action items also strive to measurably and meaningfully encourage the viability of agriculture around the state, but take a broader approach, seeking actions that may provide a benefit in all basins.

Interbasin Compact Committee Agricultural Viability Actions and Strategies

To inform the ongoing statewide discussion on agricultural viability, the IBCC assembled a subcommittee in 2015 to propose specific concepts and strategies for the IBCC's support and potential short-term implementation. The committee presented draft concepts for discussion to the IBCC, which approved the action items for further work and implementation. Moving forward, the CWCB's members and staff will work with stakeholders and interested parties to implement these concepts, while recognizing the challenges and opportunities presented by each. The following summary describes briefly each of the IBCC concepts.

Agricultural Viability Long-Term Goal: The IBCC asked the task group to craft a long-term goal closely tied to continued long-term viability for agricultural uses, and to reflect the broad need to educate Coloradans on the importance of agriculture. Ideally, the goal should be measurable.

Program to Facilitate Agricultural Opportunities: Additional education and assistance to farmers and ranchers is needed to help realize more transactions that allow for water sharing and for new Colorado farmers to own land. The program should include education on and assistance with the following:

- Deals, contracts, and other options for sharing agricultural water,
- ATMs that allow for the farmer to continue owning the land,
- Opportunities to overcome entry barriers for young growers (in collaboration with such entities as Land Link, Farm Bureau's Young Farmer Group, and Colorado State University Extension),
- Perpetual agricultural agreements, such as conservation easements (such as those demonstrated by entities like the Lower Arkansas Valley Water Conservancy District),

- Other similar contractual agreements that allow for more long term flexibility (an example is the purchase of water rights in the Arkansas Basin by Aurora Water).
- Funding opportunities for agricultural producers.

The scope of work, goals, geographic range, and responsibilities of this program need to be created, along with measurements for success. Because many of the aspects of the program relate to agreements between municipalities and agricultural producers, both sectors should be involved in the development of the program and provide continued input.

Enforcing minimum standard for water rights applications: The court should be diligent in enforcing the minimum water rights application requirements, which are already in existence. This should be standardized statewide. Better guidance for applicants who do not have legal counsel or engineering consultants should be provided and advertised.

Incentives to reduce urbanization and fragmentation of agricultural lands: Colorado's Water Plan should indicate that the current land use incentives described in the plan would also help keep agricultural lands in production. These incentives should be reviewed to determine if more are needed to further encourage local governments and land owners to reduce fragmentation and urbanization of agricultural lands. The incentives are meant to provide additional options, but not infringe upon private property rights.

Addressing barriers to keeping agricultural land and water ownership when water sharing: Members of the IBCC will work with BRTs to apply for a multi-basin WSRA grant to compile ATM data, identify areas that will encourage irrigators to enter agreements, analyze barriers (not just law review), and bring in municipalities' perspectives to understand both buyer and seller standpoints. We can develop next steps once this data has been compiled and reviewed.

Framework for evaluations of agricultural transfers: More transparency is needed with agriculture transfer transactions, so that agriculture producers and the general public understand the effect of agriculture transfers to agriculture, the local community, and the environment. An evaluation of agricultural transfers could help, but there are several concerns and details that would need to be determined. An evaluation of agricultural transfers could encroach on private property rights, stall operations, and become a permitting hurdle functioning like an Environmental Impact Statement. Other remaining details include: determination of the party responsible for conducting the evaluation, the end goal of such an evaluation, the effect on agricultural viability, and timing of such an evaluation in the water rights transaction process. A framework for an evaluation of agricultural transfers should be developed from a technical and legal perspective before the consideration of requiring such an evaluation. Stakeholders should be relied upon to help produce such a framework, and include local government, agricultural producers, municipalities, and environmental interests.

Agricultural to agriculture, environment, or industrial sharing pilot: Senate Bill 198 was signed in 2015, which allows for pilot projects to share water between agricultural entities, as well as industrial or nonconsumptive uses. To implement this program, the CWCB should encourage a

pilot project to test the concept. In addition, ditch companies should be educated on this opportunity. Some ditch companies may need to change their bylaws to allow for this.

Update and improve Colorado's aging infrastructure: Building new storage and other infrastructure and updating aging infrastructure is too expensive and difficult for many agriculture producers (regulations, permits, costs). Storage benefits and supports all uses and all sectors. Therefore, other work on improving the permitting, system, review of water administration, court system, and law, as well as increased funding for aging infrastructure and identified agricultural projects is encouraged.

Regulations that increase costs for growers and how these might be modified: The agricultural community needs relief from increasing government regulations across sectors, which must be addressed as one of agriculture's top priority issues for the future, especially when encouraging young agriculturalists to continue farming.

Additional recommendations: In addition, the IBCC discussed the need for two additional points focused on funding agricultural infrastructure and agricultural IPPs. The latter recommendation will support agricultural and municipal IPPs that reduce reliance on agricultural dry-up.

Maintenance of Existing Projects and Methods

New projects and methods will be critical for meeting Colorado's water supply needs. However, existing infrastructure and currently operational projects and methods require maintenance and upkeep, which are just as important as bringing new methods online. In evaluating funding mechanisms for future projects, many proponents will include operations and maintenance costs within the proposed budget. For many federal projects, maintenance costs are included in repayment contracts, or are associated with power revenues. For many municipal projects, maintenance costs are passed on to the ratepayer. Funding mechanisms through entities such as the CWCB, as discussed in Section 9.2, are available for the costs associated with maintenance, repair, and improvements.

Every BIP includes goals to modernize water infrastructure or improve agricultural efficiencies. Through the BIP process, many basins also identified operations, maintenance, and improvements as part of their plan for future needs. For example, the North Platte Basin had 10 projects that identified ditch and diversion improvements as their primary benefit. In these agriculturally focused basins, improvements to conveyance systems will be of high importance when planning for future needs.³⁸⁸ The Gunnison Basin Roundtable identified 22 projects classified as storage improvements and expansion: either maintaining existing reservoirs or planning for more storage.³⁸⁹ The Colorado Basin similarly listed many projects associated with storage expansion, and also plans for improving or updating existing municipal infrastructure.³⁹⁰ In this manner, the basins are preparing for new projects and methods, while maintaining the existing supply systems.

Actions

To support projects and methods that meet future municipal, industrial, and agricultural needs, several next steps are necessary.

1. **BIP project support:** The CWCB will continue to support and assist the basin roundtables in moving forward the municipal, industrial, and agricultural projects and methods identified in their BIPs, through technical financial and facilitation support when requested by a project proponent.
2. **Climate change incorporation:** The CWCB will work with the basin roundtables and, upon request, work with project proponents, to incorporate the potential effect of climate change on municipal, industrial, and agricultural projects and methods.
3. **Expanding projects to be multi-purpose:** The CWCB will prioritize funding to the basin roundtables to support an integrated approach to understanding how environmental and recreational projects and methods may interact with municipal, agricultural, and industrial projects and methods. As part of this task, basin roundtables will work with local stakeholders and project proponents to explore multi-purpose projects and convert existing and planned single-purpose projects and methods into multi-purpose ones.
4. **Project tracking:** In partnership with the basin roundtables, the CWCB will continue to track municipal, industrial, and agricultural projects and methods.
5. **Project support:** The CWCB will continue to support and implement state programs that contribute to implementing municipal, industrial, and agricultural projects and methods. These include loan and grant programs, as well as ongoing studies such as the Statewide Water Supply Initiative.
6. **Project funding:** As discussed in Section 9.2, the CWCB will work with partners to strengthen funding opportunities for municipal, industrial, and agricultural projects and methods by:
 - a. Coordinating current funding
 - b. Assessing funding needs
 - c. Exploring additional funding opportunities
7. **Storage opportunity assessment:** As part of the next version of SWSI, the CWCB will work with the DWR and local partners to assess storage opportunities to determine where existing storage can and should be expanded, where it is needed to prepare for climate change, where it can be used to better improve sharing and use of conserved water, and where it can help meet Colorado's compact obligations. Furthermore, the CWCB will provide financial support to technical and practical innovations in the use of aquifer storage and recharge where it is practicable.
8. **Multi-purpose project funding:** The CWCB will prioritize support for multi-purpose projects and those that modernize, make more efficient, or build new critical infrastructure for agriculture, M&I uses, and hydropower production through programs explored in Section 9.2.
9. **Permitting:** As discussed in Section 9.4, refine the permitting process to make it more effective and efficient.
10. **Program to facilitate agricultural opportunities:** The CWCB and the CDA will establish an education and assistance program for farmers and ranchers to help realize more transactions that allow for water sharing and for new Colorado farmers to own land. The scope of work, goals, geographic range, and responsibilities of this program need to be created along with measurements for success. Because many of the aspects of the program

relate to agreements between municipalities and agricultural producers, both sectors should be involved in the development of the program and provide continued input.

11. **Enforcing minimum standard for water rights applications:** The court should be diligent in enforcing the minimum water rights application requirements, which are already in existence. This should be standardized statewide. Better guidance for applicants who do not have legal counsel or engineering consultants should be provided and advertised.
12. **Framework for evaluations of agricultural transfers:** A framework for an evaluation of agricultural transfers will be developed from a technical and legal perspective before the consideration of requiring such an evaluation. The CWCB will host a stakeholder group to help produce such a framework, which will include local government, agricultural producers, municipalities, and environmental interests.
13. **Update and improve Colorado's aging agricultural infrastructure:** Over the next five years, the CWCB will work with the basin roundtables and agricultural partners to further identify and prioritize aging infrastructure projects, especially where there can be a large effect on or benefits to other sectors. The CWCB will coordinate funding opportunities to address these needs.
14. **Encourage ditch-wide and regional planning:** Over the next two years, the CWCB will work with agricultural partners to explore opportunities to conduct ditch-wide and regional planning, such as that occurring in the Uncompahgre. These plans will explore system-wide conservation and efficiency opportunities, as well as explore the potential for water sharing, and develop a long-term infrastructure maintenance and upgrade plan

6.6 Environmental and Recreational Projects & Methods

The policy of the state of Colorado is to identify and implement environmental and recreational projects and methods to achieve the following statewide long-term goals:

- Promote restoration, recovery, sustainability, and resiliency of endangered, threatened, and imperiled aquatic and riparian dependent species and plant communities
- Protect and enhance economic values to local and statewide economies derived from environmental and recreational water uses, such as fishing, boating, waterfowl hunting, wildlife watching, camping, and hiking
- Support the development of multi- purpose projects and methods that benefit environmental and recreational water needs as well as water needs for communities or agriculture
- Understand, protect, maintain, and improve conditions of streams, lakes, wetlands, and riparian areas to promote self- sustaining fisheries and functional riparian and wetland habitat to promote long-term sustainability and resiliency
- Maintain watershed health – protect or restore watersheds that could affect critical infrastructure and/or environmental and recreational areas

The importance of Colorado's natural environment and recreational opportunities to its quality of life and to its economy cannot be overstated. Outdoor recreation (including hunting, fishing, biking, hiking, skiing, golfing, wildlife watching and many other types of outdoor activities) significantly contributes to Colorado's economy, with nonconsumptive water-based recreation an important part of that economy. Healthy watersheds, rivers and streams, and wildlife are vital to maintaining Colorado's quality of life and a robust economy. Section 5 of Colorado's Water Plan

contains more information about the economic benefits that recreational activities provide to the state.

This section details the projects and methods by which nonconsumptive river-based environmental and recreational water needs have been protected in the past, as well as how these values may be maintained in the future. This will be accomplished by describing the benefits of such projects and methods, and providing existing examples. The section contains several subparts: 1) an overview of existing tools for assessing environmental and recreational needs; 2) an account of knowledge gaps; 3) an overview of environmental and recreational statutes and recent legislation; and 4) a description of projects and methods contained in the eight BIPs.

While water is vital to many kinds of recreation, including skiing and sports that require grassy areas, like soccer, golf, and baseball, this section focuses on recreational uses of water in Colorado's streams and rivers, defined by roundtables as primarily nonconsumptive. Section 5 of Colorado's Water Plan addresses the importance of recreational water needs that involve consumptive uses of water primarily associated with municipal or SSI uses (e.g., irrigation of parks and golf courses, snowmaking).

Overview

Water is a crucial element in maintaining the environmental and recreational values important to Coloradans. Adequate streamflows support the outstanding fisheries in the upper Arkansas River, rafting through Glenwood Canyon, snowmaking for world-class ski areas, and maintaining habitat for the water-dependent natural environment. A healthy environment depends upon good water quality, connectivity of streams, and robust instream and riparian habitats. Careful water management and dedication of significant resources have also resulted in progress towards recovering threatened and endangered species.³⁹¹

Meeting environmental and recreational needs must be included as an important piece of comprehensive water planning, along with agricultural, municipal, and industrial needs. The IBCC's draft conceptual agreement supports this concept and states,

Colorado's Water Plan, BIPs, and stakeholder groups across the state should identify, secure funding for, and implement projects that help recover imperiled species and enhance ecological resiliency whether or not a new [TMD] is built. This could create conditions under which future projects may be possible.... These existing environmental and recreational gaps should be meaningfully addressed in the near term.³⁹²

Projects and methods that maintain or improve Colorado's environmental and recreational values and achieve long-term sustainability and environmental resiliency are an important part of Colorado's water future. Resilience of a stream or watershed can be measured as an ecosystem's ability to recover function after a disturbance, whether acute or chronic.^e The resilience of an

^e See Principle 7 of the IBCC Draft Conceptual Agreement.

ecosystem is a measure of its ability to absorb changes and still exist.^f Resilient river systems provide complex and connected aquatic and riparian habitats, and support diverse, abundant, and reproducing populations of aquatic and riparian species. To determine levels of resiliency, it is necessary to identify the baseline status of these characteristics and to monitor streams and watersheds on an ongoing basis.³⁹³ To promote environmental resiliency, planned projects and methods should incorporate the potential stressors of drought and climate change, including decreased supply and changes in runoff timing.

The challenges faced by environmental and recreational project proponents in the future include making the most of limited funding opportunities. Environmental and recreational needs have a host of non-governmental proponents; however, funding opportunities are scarce when compared with existing programs for municipal, industrial, or agricultural uses.³⁹⁴ In addition to strengthening existing and exploring additional funding opportunities for environmental and recreational projects and methods, strategic partnerships also will play an important role in such projects and methods. Those seeking to fund additional storage or a new diversion may find that working with a diverse group of stakeholders from the beginning will make the process more successful. The BIPs have identified new multi-purpose projects or methods as desirable. Working towards an environmental or recreational use to be associated with the project will garner support from a wider range of stakeholders. For example, if a new storage project could identify a potential associated recreational opportunity, such as boating or fishing, a greater range of advocates can be counted on to support the project through permitting and financing. Another example is including a project component focused on habitat or flow restoration to address environmental and recreational needs. Water quality and habitat degradation effects resulting from traditional consumptive uses of water could be addressed with restoration projects and methods and coordinated water uses among water users. Such a balanced approach to meeting future water needs could accomplish multiple objectives.

This sort of strategic cooperation on environmental and recreational projects and methods has proven to be a successful mechanism in the past, as will be examined later in this section and further discussed in Section 9.3. In planning for this sort of multi-purpose project or method, proponents should take into account the watershed nature of projects and methods, and the manner by which they influence more than just one particular stream reach.³⁹⁵ With an eye to serving multiple purposes, proponents may also consider a project or method that meets multiple environmental and recreational purposes in a reach where it has the most beneficial outcome.

With multi-purpose projects and methods in mind, it is important to note that many environmental and recreational attributes benefit from more traditional existing consumptive uses. Although there can be impacts to the environment and recreational interests from municipal or agricultural projects, these uses can also provide benefits. A reservoir provides wildlife and fish habitat and recreational opportunities for visitors, and provides a mechanism for beneficial management of stream flows. Agricultural water uses also provide these types of benefits. The cultivation of crops

^f See <http://torrensresilience.org/ecological-resilience> (citing Holling, C.S. 1973. "Resilience and stability of ecological systems" in: *Annual Review of Ecology and Systematics*. Vol 4 :1-23).

around the state provides habitat and open space for many species, and the agricultural tourism sector has boomed in Colorado, with wineries and orchards around the state bringing visitors and development to agriculturally-centered communities. While these direct benefits are obvious, agricultural diversions also offer some indirect benefits. Diversions that occur in the irrigation season come back to the stream in the form of return flows. These late-season return flows that occur in early fall provide a boost to stream flows that would otherwise not be present. These retimed flows benefit riparian health and provide instream habitat.

Existing Environmental and Recreational Projects & Methods

Recognizing the value of a robust recreational economy and the obvious benefits of healthy ecosystems, Colorado has implemented programs and invested in projects to protect and improve these attributes. Below are some examples of these types of programs and projects.

Colorado's Instream Flow and Natural Lake Level Program

In 1973, the Colorado legislature recognized the need to “correlate the activities of mankind with some reasonable preservation of the natural environment” and passed Senate Bill 73-097, creating the State’s Instream Flow and Natural Lake Level Program.³⁹⁶ This program, one of the nation’s first, vested the CWCB with exclusive authority to protect streamflow through a reach of stream rather than just at a point, and to protect levels in natural lakes. Before this law was passed, all appropriations of water in Colorado were required to divert water from its natural course in the stream.³⁹⁷ Senate Bill 73-097 removed the diversion requirement for the CWCB and allowed the Board to appropriate water instream between specific points on a stream, and for levels on natural lakes.³⁹⁸

Any person or entity may recommend streams and lakes for appropriation to preserve the natural environment. The CWCB also is required to request recommendations from Colorado Parks and Wildlife (CPW), the U.S. Department of Agriculture, and the U.S. Department of the Interior.³⁹⁹ The CWCB uses a public notice and comment procedure in determining whether to appropriate instream flow water rights.⁴⁰⁰ Before applying to water court for an instream flow water right, the CWCB must determine that: (1) there is a natural environment that can be preserved to a reasonable degree with the instream flow water right; (2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation; and (3) such environment can exist without material injury to water rights.⁴⁰¹ Once decreed by the water court, instream flow water rights are administered within the State’s water rights priority system like any other water right in the state. The CWCB has legal standing in water court to protect instream flow water rights from injury at any point within an instream flow reach.

The CWCB also can acquire water, water rights, and interests in water to preserve and improve the natural environment on a permanent or temporary basis from willing water rights owners. The acquisition process includes a biological analysis by CPW, the CWCB’s consideration of several factors related to the transaction, and opportunity for public input.^g

^g C.R.S. § 37-92-102(3), § 37-83-105(2), and Rule 6 of the CWCB’s Rules Concerning the Colorado Instream Flow and Natural Lake Level Program govern the CWCB’s acquisition of water for instream flow use. The

Since 1973, Colorado has appropriated instream flow water rights covering more than 9,200 miles of stream and natural lake level water rights on 486 natural lakes.⁴⁰² This protection represents approximately 30 percent of the perennial stream miles in the state. Instream flow water right appropriations: (1) protect healthy native and sport fish populations, aquatic insects, and rare and distinctive riparian vegetation communities; (2) achieve federal agencies' resource protection goals through a state-held water right; (3) are a key element of a stakeholder group plan developed as an alternative to suitability for Wild and Scenic designation of three reaches of the Colorado River; and (4) provide numerous other benefits to the citizens of Colorado. See Appendix C for some specific examples of instream flow water right appropriations. The CWCB has encouraged entities who recommend instream flow appropriations to focus on streams that provide habitat for threatened, endangered and imperiled native species.

In addition, the CWCB has completed 26 water acquisition transactions, including acquisitions to protect critical habitat for endangered species on the Yampa River, to improve^h the natural environment of the Blue River downstream from Dillon Reservoir, to restore native flows to a degraded stream system near Silverton, Colorado, and to re-water a historically dried-up stream near Crested Butte, Colorado.ⁱ See Appendix C for some specific examples of water acquisitions for instream flow use.

Recreational In-Channel Diversions (RICDs)

Colorado is one of several states that authorize the appropriation of water rights for recreational boating purposes within a natural stream. However, Colorado is the only state that allows for the appropriation of water rights for recreational boating uses associated with man-made whitewater parks, specifically requiring structures in the stream that create recreational experiences. These water rights are known in Colorado as RICDs.^j These water rights allow water to be called for recreational boating purposes when in priority. The size and magnitude of river flows called by some RICD water rights, depending on their location, have the potential to restrict future upstream development potential and may reduce the flexibility that Colorado has to manage its water resources. Colorado law limits RICDs to the minimum stream flow necessary for a reasonable recreational experience and must be diverted through a control structure, often a whitewater park itself.⁴⁰³ Only a local governmental entity may apply for a RICD.⁴⁰⁴ The statutes require that any application to water court for an RICD must be considered by the CWCB after deliberation in a public meeting to determine whether the proposed RICD will:

Rules are located at:

<http://cwcb.state.co.us/legal/Documents/Rules/Final%20Adopted%20ISF%20Rules%201-27-2009.pdf>.

^h In 2002, the General Assembly passed Senate Bill 156, authorizing the CWCB to use acquired water to improve the natural environment to a reasonable degree (C.R.S. § 37-92-102(3)).

ⁱ Information on CWCB's instream flow water acquisitions is located at:

<http://cwcb.state.co.us/environment/instream-flow-program/Pages/CompletedTransactions.aspx>.

^j C.R.S. § 37-92-102 (5, 6), § 37-92-103(10.1, 10.3), § 37-92-305(13), and the CWCB's Recreational In-Channel Diversion Rules govern RICD appropriations. The rules are located at:

<http://cwcb.state.co.us/legal/Documents/Rules/RICDrules2006Novhearing.pdf>.

1. Promote the maximum beneficial use of waters of the state;
2. Not impair Colorado's ability to fully develop and use its compact entitlements; and
3. Not cause material injury to the CWCB's instream flow water rights.⁴⁰⁵

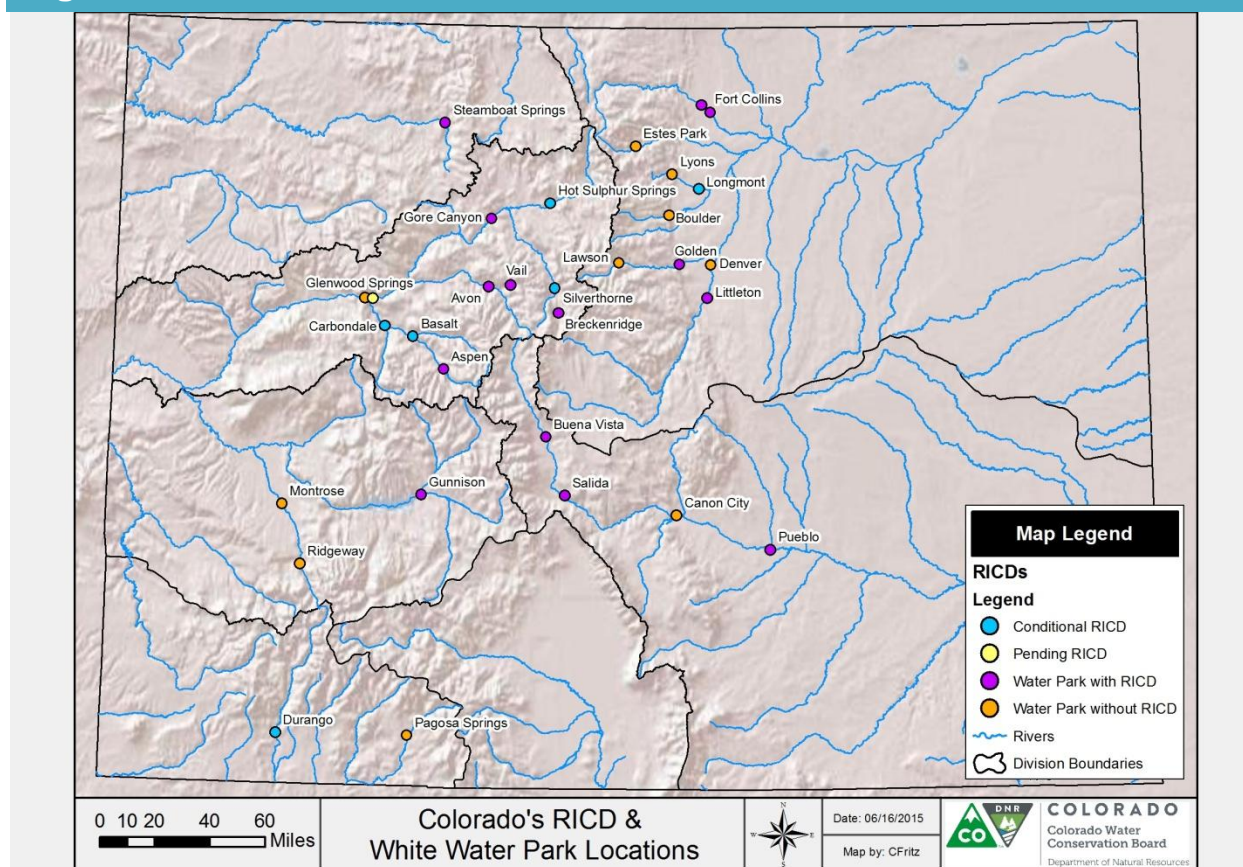
To ensure that a proposed RICD adequately meets these requirements, the CWCB has encouraged applicants to include specific provisions within their proposed water court decrees. These specific provisions have included concepts such as "carve-outs" and "no-call provisions." Examples of these specific provisions may be found in the CWCB's past findings of facts located at <http://cwcb.state.co.us/environment/recreational-in-channel-diversions/Pages/PendingandDecreedRICDs.aspx>.

The CWCB then provides its findings to the water court for consideration. The water courts must also consider whether:

1. The water right sought is the minimum necessary for a reasonable recreational experience;
2. The RICD is accessible to the public; and
3. The RICD includes only that stream reach that is appropriate for the intended use.⁴⁰⁶

In Colorado, there are 15 existing whitewater parks with RICD water rights and eight existing whitewater parks that operate without an RICD water right. Colorado's existing and planned whitewater parks are illustrated in the map below (Figure 6.6-1).

Figure 6.6-1: Colorado's RICD & White Water Park Locations



Endangered Species Recovery Programs

Many of Colorado's water projects are likely to have what is known as a "federal nexus." A water project is considered to have a federal nexus if it involves federal funding, federal permitting or licensing, use of federal lands, or a federal program. The existence of a federal nexus often triggers the need for consultation under Section 7 of the Endangered Species Act.⁴⁰⁷ The result of a Section 7 consultation is a biological opinion that states whether a project is likely to jeopardize the continued existence of listed threatened or endangered species or result in the destruction or adverse modification of critical habitat.

To mitigate these effects, Colorado participates in three cooperative programs to protect and recover stream-dependent species in various river basins. The Upper Colorado, San Juan, and Platte River Recovery Programs provide organized collaboration among states, Federal agencies, local agencies, water users, water providers, power providers, and environmental organizations. The Three Species Agreement differs from these programs, as described below. The goal of the programs is to recover the endangered species while allowing water use and development to continue, in compliance with all applicable state and federal laws and interstate compacts.

Funding and resources from participants are dedicated to activities that benefit the species.

Collaboration and focus on recovery activities are intended to:

- maximize benefit to the species and the environment from the funding and resources expended,
- minimize resources spent on adversarial activities, including litigation,
- provide Endangered Species Act compliance for water users,
- streamline Section 7 consultations for water users and Federal agencies,
- reduce uncertainty and delays in planning and permitting processes,
- reduce likelihood of jeopardy opinions.

Upper Colorado River Endangered Fish Recovery Program

The Upper Colorado River Endangered Fish Recovery Program was established in 1988 as a unique partnership of various interests in Colorado, Wyoming and Utah working towards recovery of four endangered fish species: humpback chub, bonytail, razorback sucker, and Colorado pikeminnow. These species are long-lived warm-water fish endemic to the Colorado River Basin. Recovery efforts focus on creating self-sustaining populations of native fish through restoration and management of habitat, propagation and stocking of hatchery-raised fish, and management of certain deleterious non-native fish species throughout the mainstem Colorado, Gunnison, Yampa, White, and Green River Basins.

The Upper Colorado Endangered Fish River Recovery Program provides Endangered Species Act compliance for more than 2,050 water projects with more than 2.5 million acre-feet of existing water use and more than 300,000 acre-feet of new development. No lawsuits have been filed regarding the Endangered Species Act compliance of any of these water projects. Procedures, projects, and agreements have been established to provide streamflow protection, voluntary flow augmentation during critical spring peak and late summer time periods, habitat management and improved habitat access, genetic propagation, hatchery and stocking operations, non-native fish control efforts, and research and monitoring. The cooperative nature of the program has led to multiple successes and cost-efficiency, and the program has become a model for other endangered species recovery programs.^k

San Juan River Basin Recovery Implementation Program

The San Juan River Recovery Implementation Program was established in 1992 for this major tributary to the Colorado River. The Navajo Nation, Jicarilla Apache Nation, Southern Ute Indian Tribe, and Ute Mountain Ute Indian Tribe are active partners in this collaborative effort to recover the razorback sucker and Colorado pikeminnow within the San Juan River Basin in Colorado and New Mexico.

The San Juan River Basin Recovery Implementation Program provides Endangered Species Act compliance for more than 340 water projects using more than 880,000 acre-feet of water in the San Juan River Basin. Major accomplishments include extensive research in biology and geomorphology, and the establishment of procedures and agreements to provide streamflow

^k Information on the UCCRIP is located at: <http://www.coloradoriverrecovery.org/index.html>.

augmentation and protection, habitat management and improvement, genetic propagation, hatchery and stocking operations, non-native fish control, and continued research and monitoring.^l

Platte River Recovery Implementation Program

During the early 1990s, all Endangered Species Act Section 7 consultations conducted on Platte River projects received jeopardy biological opinions, which meant that these water projects could not proceed. In response, Colorado, Nebraska, Wyoming, and the Department of the Interior entered into a collaborative conservation partnership with many other stakeholders now known as the Platte River Recovery Implementation Program.^m

The Platte River Recovery Implementation Program is now working to recover four threatened and endangered species (the whooping crane, interior least tern, piping plover, and pallid sturgeon) in Nebraska, which in turn, allows water use and development to continue on the Platte River. This program involves the states of Wyoming, Nebraska, and Colorado, federal agencies, and many water, power, and environmental interests. This Program provides Endangered Species Act compliance for water projects and fully complies with the participating states' water law as well as existing interstate river compacts and decrees. The program is being implemented in an incremental manner, with the first increment programmatic biological opinion covering the 13-year period from 2007 through 2019.

The Platte River Recovery Implementation Program has been officially in place since 2007, and has provided 237 successful streamlined Section 7 consultations using the programmatic biological opinion for any Colorado entity that joins the South Platte Water Related Activities Program. The preceding Cooperative Agreement, signed in 1997, resulted in bridge measures to allow for Endangered Species Act compliance for approximately 120 Platte River basin consultations while negotiations were underway.

Through 2019, South Platte water users will pay more than \$13 million and the State of Colorado will pay \$24 million (according to 2005 inflation rates) for Platte River Recovery Implementation Program. However, the program is thought to be well worth the cost when compared to the untold cost that water users would likely face without the program, including:

- Undergoing uncertain, individual Section 7 consultations including bearing the risk of receiving jeopardy biological opinions,
- Potentially being required to replace past and future depletions on a one-to-one basis, which will likely add additional pressure to dry up agriculture,
- Delays in the planning and permitting process, and
- The risk of having existing programmatic biological opinions challenged in court

^l Information on the SJRIP is located at: <http://www.fws.gov/southwest/sjrip/>. Also, detailed summaries of the UCRIP and SJRIP programs can be found at: www.coloradoriverrecovery.org/general-information/general-publications/briefingbook/2014HighlightsDig.pdf.

^m Information on the PRRIP is located at: <https://www.platteriverprogram.org/Pages/Default.aspx>.

Three Species Agreement

CPW, five other Colorado River Basin state wildlife agencies, the U.S. Forest Service (USFS), the Bureau of Land Management (BLM), the Bureau of Reclamation, and sovereign tribes are parties to a multi-state, multi-agency, rangewide conservation and strategy agreement that provides the framework for conservation actions designed to preserve three declining native fish species: roundtail chub, bluehead sucker, and flannelmouth sucker, across their historic range.⁴⁰⁸ Noting rangewide declines of these species, the Three Species Agreement addresses the species' potential for listing by the U.S. Fish and Wildlife Service (USFWS) as threatened or endangered under the Endangered Species Act of 1973, as amended. The USFWS relies on implementation of the multi-state Three Species Agreement to protect and conserve these three native warm-water species.

The Three Species Agreement provides that within their jurisdictional authorities, signatories are responsible for taking action to conserve native fish, coordinating status assessments, developing and maintaining data sets on occupancy and genetics, and documenting conservation measures taken on behalf of the three species. It encourages all signatories to cooperate on science, research, education and outreach to send a clear and consistent message about conservation of these species. The agreement is predicated on the concept that collectively, local, state, and federal agencies, and other willing partners can work together with the communities most affected by a potential listing to develop and implement voluntary actions that pre-empt the need for federal listing of any of these species under the Endangered Species Act. Establishment of instream flow protection for streams known to provide habitat for the three species is identified as a priority conservation action under this agreement. CPW and the BLM have recommended that the CWCB appropriate instream flow water rights to preserve the habitat of the three species. A recent example of such an appropriation is an instream flow water right on the San Miguel River from Calamity Draw to the confluence with the Dolores River, decreed in May 2013.

Colorado River Cutthroat Trout Conservation Strategy

Colorado River cutthroat trout (CRCT) is a state-listed species of special concern in Colorado, Wyoming, and Utah and also is characterized as a sensitive species by federal land management agencies (the BLM and the USFS) who manage habitats where CRCT occurs. CPW works closely with Utah, Wyoming, and federal land managers to manage for the recovery and persistence of CRCT throughout their historic range, guided by the Conservation Strategy for Colorado River Cutthroat Trout, a multi-pronged strategy that articulates the steps that if implemented, would be most likely to preserve CRCT in perpetuity.⁴⁰⁹ Implementation of the CRCT Conservation Strategy and showing progress on measurable benchmarks has allowed the USFWS to maintain its opinion that CRCT is "not warranted" for listing under the Endangered Species Act of 1973, as amended.⁴¹⁰ This finding has been beneficial to state wildlife management agencies to maintain state management authority for this species, and also is critically important to water managers so that consultation with the USFWS under Section 7 of the Endangered Species Act is not required for projects in CRCT-occupied waters.

In general, the CRCT Conservation Strategy focuses on the following objectives:

- Identify populations of CRCT and characterize the level of genetic introgression;

- Secure “conservation” and “core conservation” populations from further genetic dilution (from non-CRCT salmonids) or inter-specific competition (e.g., barrier construction, reclamation, stocking restrictions);
- Maintain and enhance watershed conditions, including streamflow protection, riparian buffers, and habitat projects;
- Public outreach and education;
- Monitoring and data exchange among state fish managers and federal land management agencies; and
- Coordination of all CRCT activities among the same agencies and non-governmental organization partners.⁴¹¹

As outlined in the CRCT Conservation Strategy, maps, regulations, and CRCT conservation waters are continually being updated as new monitoring data and research unfolds. Of current interest is the further delineation of historic native cutthroat trout into two distinct lineages reflecting pre-settlement occupation endemic to the Yampa-White river basins (“blue” lineage) or the Colorado-Gunnison-Dolores river basins (“green” lineage).⁴¹² Regardless of the nomenclature for particular genotypes of native cutthroat trout, the CRCT Conservation Strategy partners will continue to evolve management strategies to address new challenges (e.g., climate change) and research findings.

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act requires federal land agencies (including the BLM, the National Park Service, the USFS, and the USFWS) to identify and evaluate rivers that may be “eligible” and “suitable” for designation as a wild and scenic river, through their land and resource management planning processes.⁴¹³

To be eligible, a river, stream, or segment must be free-flowing and must possess at least one Outstanding Remarkable Value (ORV), including scenic, recreational, geologic, fish and wildlife, historic, cultural, or similar values. Once eligibility is established, those rivers or river segments are then evaluated for their suitability for designation as a wild and scenic river.⁴¹⁴ Many factors are considered in the suitability evaluation, including whether there is a demonstrated commitment to protect the river and its ORVs by nonfederal entities who may implement protective management.

River segments found suitable may be recommended for designation as a Wild and Scenic river. However, designation may only be done by an act of the Secretary of the Interior (upon request by a Governor) or by an act of Congress. Currently, there are many river segments in Colorado that the USFS or the BLM have determined to be suitable for designation since the passage of the original Wild and Scenic Rivers Act in 1968.

If a river is designated as a Wild and Scenic river, a federal reserved water right is created for a quantity of water necessary to achieve the Act’s purposes, including protecting the ORVs for which a river is designated. However, it is up to the managing agency whether to quantify, adjudicate, or request enforcement of the federal water right. In this context, Colorado can work with local

managing agencies to protect flows that can support ORVs using Colorado's Instream Flow Program. Additionally, federal land management agencies may protect the free flowing nature, water quality, and classification associated with ORVs for candidate (eligible and suitable) Wild and Scenic rivers by imposing conditions on permits or other federal land management decisions. Federal land management agencies review proposed projects in, above, or below a designated reach to determine if "they would invade the area or unreasonably diminish the Outstandingly Remarkable Values."⁴¹⁵ If so, the agency may request project proponents to modify the project to avoid adverse effects. If the proposed project cannot be modified, the permitting agency may deny the request for a federal permit or assistance. While federal agencies have determined that several rivers in Colorado are suitable for designation (e.g., Dolores and Arkansas rivers) and manage them as suitable in the absence of Congressional designation, water development and management have proceeded.

In 2009, Colorado's General Assembly established the CWCB Wild and Scenic Rivers Act Alternatives Fund to support cooperative and collaborative processes that are committed to exploring alternative avenues for resource protection.⁴¹⁶ These processes typically consist of stakeholder groups aimed at protecting the Outstandingly Remarkable Values associated with rivers within Colorado, while protecting Colorado's ability to fully use its compact and decree entitlements through finding alternatives to Wild and Scenic designation that satisfy the federal agencies' requirements to protect the Outstandingly Remarkable Values. Representatives of diverse interests, including state agencies, local governments, conservation groups, and recreation groups, and individuals participate in these stakeholder groups, each bringing a different perspective to the group's work.

The Cache la Poudre River is the only river in Colorado currently designated as a wild and scenic river.⁴¹⁷ However, several river segments in Colorado are currently being evaluated for wild and scenic eligibility and suitability by the BLM and the USFS as part of their current land and resource management planning processes. Currently, there are three active stakeholder groups utilizing the Wild and Scenic Fund to discuss the merits of suitability findings and in most cases, to develop alternative ways of protecting the Outstandingly Remarkable Values identified by these federal agencies: the Upper Colorado River Wild and Scenic Stakeholder Group, the River Protection Workgroup (working in southwest Colorado), and the Dolores River Dialogue's Lower Dolores Plan Working Group. Additionally, the South Platte Enhancement Board has been active since 1997 to implement its alternative plan to a possible designation under the Wild and Scenic Rivers Act.⁴¹⁸

State of Knowledge

As part of the process established in 2005 by the Colorado Water for the 21st Century Act, the nine basin roundtables and the CWCB have worked to identify Colorado's environmental and recreational water needs, also referred to as nonconsumptive needs. Below is a brief description of some of the resources that have been developed so far. Nevertheless, it is apparent that there is additional work that can be done to develop common metrics for environmental and recreational attributes and to develop focused, basin-specific knowledge of environmental and recreational needs.

SWSI Phase 1—Nonconsumptive Mapping (2010)

As part of the nonconsumptive needs assessments, each basin roundtable mapped where important nonconsumptive attributes exist. These reaches or watersheds are known as "focus areas." Each focus area is associated with one or more attributes such as imperiled fish species, important boating and fishing areas, important water fowl hunting areas among others.⁴¹⁹ Environmental attributes identified by the roundtables include federal and state threatened, endangered, and imperiled species (e.g., piping plover, greenback cutthroat trout, boreal toad, bluehead sucker); significant riparian wetland plant communities; and special value waters (e.g. the CWCB's instream flow water rights, eligible Wild and Scenic rivers).⁴²⁰ Recreational attributes identified by the roundtables include whitewater and flatwater boating; cold and warm water fishing; Audubon important bird areas; waterfowl hunting and wildlife viewing.

SWSI Phase 2—Nonconsumptive Projects and Methods (2010)

Phase 2 determined where planned and existing nonconsumptive projects and methods, also known as identified projects and processes, are located in relation to the focus areas developed in Phase 1. This information can be used to determine where known nonconsumptive identified projects and processes offer direct or indirect protection for a specific attribute, and equally as important, where there are no known protections for a given focus area. For example, based upon this information, important riparian and wetland areas cover 18,767 stream miles statewide.⁴²¹ Of those miles, existing and planned projects and processes provide or will provide direct protection to 2 percent, a combination of direct and indirect protection to 2 percent, and indirect protection to 23 percent. 73 percent of those stream miles currently have no known protection in place. The survey information was organized in a database along with Phase 1 information and was summarized in maps created using geographic information system.⁴²² The maps include a list of planned nonconsumptive projects and methods, and show: 1) where planned and existing projects and methods overlap with the nonconsumptive focus areas and 2) where there are no known projects that support those reaches.

Watershed Flow Evaluation Tool (WFET)

The CWCB partnered with The Nature Conservancy and CDM Smith to pilot a tool known as the WFET. The WFET provides a framework for examining the risk of ecological change related to stream flow alteration at a watershed or regional level. On the other hand, site-specific quantification applies standard techniques to develop reach-based flow quantification based on historic data collection efforts. The WFET can help identify reaches where the historical alteration of stream flow has either increased or decreased risk to a given attribute, such as a cold water fishery, warm water fishery, and riparian vegetation. The WFET can also be used to project ecological responses to future streamflow scenarios resulting from new water development projects, a compact call, or climate change. To date, the Colorado and Yampa/White/Green Basin Roundtables have applied the WFET to their basins.

It is important to note that the WFET and site-specific flow quantification techniques each have different capabilities and limitations and therefore complement each other. For example, the WFET can be used to target areas that may need further site-specific studies to quantify flow needs, and site-specific quantification can help refine risk level categories identified by the WFET.⁴²³

Stream Management Plans

Stream management plans can play an important role in identifying both the needs of environmental attributes, and projects and methods that will benefit those attributes. For example, the Grand County Stream Management Plan examined approximately 30 stream reaches in the Upper Colorado River Basin to “provide a framework for maintaining a healthy stream system in Grand County, Colorado, through the protection and enhancement of aquatic habitat while at the same time protecting local water uses, and retaining flexibility for future water operations.”⁴²⁴ For each stream reach, the plan includes reach descriptions, study methodology and results, recommendations of environmental target flows, review of existing temperature and water quality data, monitoring guidelines, unique features and issues, and supporting data.⁴²⁵ Action items identified in the plan include restoration opportunities and monitoring recommendations by stream reach, and the “Learning by Doing” (similar to adaptive management) process, which includes monitoring, evaluation and adjustment of restoration opportunities, including flow enhancements, for the purpose of meeting pre-established goals.⁴²⁶

Well-developed stream management plans should be grounded in the complex interplay of hydrology, channel morphology, and alternative water use and management strategies, and should include the flow dynamics needed to support both recreational uses and ecosystem function. A stream management plan should: (1) involve stakeholders to ensure their acceptance of the plan; (2) assess existing geomorphic conditions at a reach scale; (3) identify flow needs for environmental and recreational water uses given appropriate geomorphic conditions; (4) incorporate environmental and recreational values and goals identified in a basin roundtable’s BIP; and (5) identify actions to maintain or improve flow regimes. Such plans can provide a framework for decision-making and project implementation related to environmental and recreational water needs for basin roundtables, local stakeholder groups and decision makers.ⁿ

The steps necessary to develop a stream management plan include: (1) gathering stakeholders to participate in plan development; (2) identifying the plan’s objectives; (3) identifying and prioritizing ecological and recreational values; (4) establishing flow and protection goals for streams and rivers within a given watershed; (5) collecting and synthesizing existing data describing flows for river ecosystems, boating, or other needs in the watershed; (6) assessing existing physical conditions of stream reaches, including geomorphic and riparian condition; (7) developing quantitative flow targets to meet articulated goals; (8) determining what new information is needed and the best methods for obtaining that information; (9) quantifying specific numeric flow recommendations (or ranges of flow) and assessing the potential for channel reconfiguration to support environmental and recreational values; (10) identifying temporal, geographical, legal, or administrative constraints and opportunities that may limit or assist the ability to meet environmental and recreational goals; and (11) identifying and prioritizing environmental and recreational projects and methods. Stream management plans should provide

ⁿ This summary of the elements of a stream management plan is based upon public comments that incorporated information compiled by the Colorado River basin roundtable.

data-driven flow recommendations that have a high probability of protecting environmental and recreational values on streams and rivers.^o

Section 7.1's recommendation of a collaborative approach to watershed planning that includes stakeholder involvement and management actions supported by sound science equally applies to stream management plans. An inclusive stakeholder approach expedites cooperative and integrated project planning, which leads to successful implementation of measures that will meet the needs identified in the stream management plan.

Additionally, while stream management plans can be developed independently of watershed master plans, a stronger stream management plan will result if conducted as part of, or in conjunction with, watershed master plans. Numerous watershed master plans incorporate important components of stream management plans. Future stream management plans should build off existing watershed plans and other available studies.

Conclusion

While this body of work represents an increase in the understanding of Colorado's nonconsumptive needs, more work needs to be done towards understanding and quantifying recreational and environmental needs. Additionally, information is needed on whether existing nonconsumptive identified projects and processes are sufficient to protect the environmental and recreational attributes targeted in the projects and processes. Based upon the above-described information and on information being developed by basin roundtables, stakeholder groups, and others, Colorado can work on developing a strategic approach to meeting its nonconsumptive needs to provide meaningful protection to environmental and recreational attributes.

Existing Environmental and Recreational Legislation

Instream Flow Legislation

Colorado's General Assembly established the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment."⁴²⁷ This legislation vested the CWCB with exclusive authority "on behalf of the people of the state of Colorado, to appropriate or acquire...such waters of natural streams and lakes as may be required to preserve the natural environment to a reasonable degree."⁴²⁸ Over the years, the General Assembly has amended and clarified aspects of this legislation. Highlights of recent legislation are set forth below.

In 2002, Senate Bill 02-156 authorized the CWCB to use acquired water rights to improve the natural environment to a reasonable degree.⁴²⁹ In 2003 and 2005, the General Assembly responded to the 2002 drought conditions by allowing temporary changes of water rights to instream flow purposes with State Engineer approval.⁴³⁰ In 2007 and 2008, the General Assembly established protection for water rights owners who lease water to the CWCB for instream flow use by providing that a lease to the CWCB will not reduce the historical consumptive use of a water right, and

^o This description of the steps to develop a stream management plan is based upon public comments that incorporated information from the Grand County Stream Management Plan.

eliminates the presumption of abandonment for water rights that have been used nonconsumptively by the CWCB.⁴³¹

In 2008, the General Assembly authorized an annual appropriation of \$1 million from the CWCB Construction Fund for costs of acquiring water for instream flow use.⁴³² That same year, the General Assembly authorized an annual appropriation of \$0.5 million from the Species Conservation Trust Fund for the costs of acquiring water for instream flow use to preserve or improve the natural environment of species that have been listed as threatened or endangered under state or federal law, or are candidate species or are likely to become candidate species.⁴³³ In 2009, the General Assembly established a tax credit that created a market-based incentive for voluntary donation of water rights to the CWCB for instream flow use.⁴³⁴

Recreational In-channel Diversion Legislation

In 2001, the General Assembly established authority and procedures for local government entities to apply for and hold in-channel water rights for recreational uses, referred to as RICDs.⁴³⁵ The legislation charged the CWCB with making findings of fact and submitting recommendations to the water court on RICD water court applications, and authorized the CWCB to hold hearings on such applications if requested by any party. In 2006, the General Assembly updated the procedures for RICD water rights applications and clarified the role of the CWCB's administrative process and determination of findings of fact to submit to the water court.⁴³⁶

BIP Environmental & Recreational Projects & Methods

As part of the BIP process, the basin roundtables identified projects and methods that could assist in meeting environmental and recreational needs within their basins. The process for identifying these projects and methods was unique to each basin, with roundtables collecting and organizing information through public outreach, input solicitation, and review by committees or the full roundtable. As a result, because these processes were different in each basin, the manner in which the BIPs present these projects and methods varies, with some basins identifying reaches of concern, and others consolidating existing compilations of project information.

This section examines and summarizes the work of the basin roundtables, focusing on a brief description of the process used by each basin, a general overview of projects and methods identified, and the path forward as basins move to meet their goals and measurable outcomes. For more information on the BIP process and how each basin collected and organized its environmental and recreational projects, refer to the individual BIPs, available on the Colorado's Water Plan website.⁴³⁷

Arkansas River Basin

The Arkansas Basin Roundtable undertook an ambitious public outreach process, hosting meetings around the basin to gather input and suggestions from residents. One of the hallmarks of this process was the input form designed by the roundtable, encouraging basin residents to submit ideas and projects for the roundtable's consideration. The roundtable also considered the list of IPPs from SWSI 2010, as well as focus areas or areas of concern identified by the Nonconsumptive Needs Committee.⁴³⁸

The roundtable has gathered project lists from several sources, including SWSI 2010, The Nature Conservancy, CPW, and others. The BIP also identifies projects funded by the roundtable through the Water Supply Reserve Account program, and projects or methods identified through the public input process undertaken by the roundtable. Through this inventory of potential projects, the roundtable seeks to prioritize available Water Supply Reserve Account funding, and demonstrate the type of projects that the roundtable believes conform to the basin's goals and measurable outcomes.⁴³⁹

Environmental and recreational projects are included in the BIP Project Database, classified into the database definitions of Master Needs, Preliminary Needs, and IPPs. These projects line up with the basin's environmental and recreational goals of maintaining and improving key attributes. Many of the identified projects concentrate on the protection and restoration of key habitat through diversion replacement, wetland improvement, and reoperation of currently existing storage rights. Three of the identified projects were associated with some aspect of instream habitat restoration. Two projects identified by the Committee focus on recreational needs, through activities such as boat chute improvement, restoration of campsites, and reservoir renovation with recreational needs in mind.

Arkansas Basin at a Glance

135 projects identified on the IPP List that meet environmental or recreational needs

\$65,030,000 in costs identified for **2** projects

382 stream miles identified for protection by **15** projects

Moving forward, the Arkansas Basin Roundtable plans to delve deeper into the public input received through its outreach program. Projects that meet basin goals may lead to a proponent being invited to a roundtable meeting to present on their project, and potentially work with the roundtable to meet funding needs. The roundtable plans to take a holistic view of projects and methods, including concepts such as watershed health, as it moves forward to maintain an updated inventory of activities within the basin. Geographic Information System mapping of needs is a priority of the roundtable, supporting the BIP efforts and identifying areas of concern. This path forward is planned to complement the pending revised edition of the SWSI, with projects and methods that meet the definition of an IPP specifically identified.

Colorado River Basin

The Colorado Basin Roundtable also began with an extensive public outreach campaign, as consultants interviewed water providers throughout the basin and hosted many town hall meetings and opportunities for BIP input. This outreach process yielded a comprehensive list of projects, organized by basin themes and geographical location. Similar to the Arkansas Basin approach, the roundtable believed that a comprehensive inventory of projects and methods would serve the basin well as a suite of options for moving forward and meeting their future water supply needs. Projects and methods from existing sources such as SWSI 2010 were also compiled into this inventory. Roundtable members took a closer look at the list of projects and methods, then identified representative projects in each sub-region of the basin meeting basin themes and sub-region goals. These projects were designated "Top Projects" and represent important needs both at the basin-wide and sub-region levels.

The Colorado Basin Roundtable established several themes to sum up and organize the input received from basin stakeholders. Theme #1 is: “Protect and Restore Healthy Streams, Rivers, Lakes, and Riparian Areas.”⁴⁴⁰ In its identification of Top Projects, the roundtable identified several projects that complement this basinwide theme. Central to this theme is the roundtable’s goal of establishing a basinwide stream management plan. Data gaps for environmental and recreational needs are a key issue of concern for this basin. The roundtable would like to see more progress statewide in scientifically quantifying the amounts of water necessary to maintain or improve these attributes.

The roundtable’s identification of Top Projects and methods includes many with an environmental or recreational focus. Many of the identified projects include the acquisition of water rights to restore or protect streamflow, or flow-related recreational protection. The needs of endangered species in the Colorado basin are called out in the goals and measurable outcomes of the BIP, with species recovery as a measurable outcome to be achieved through habitat improvement and addressing invasive species.

Moving forward, the roundtable plans to begin organizing the inventory of projects for potential implementation. To prioritize the projects and methods, the roundtable will examine each through the lens of the basinwide themes and will identify the projects that may serve multiple purposes or meet basin goals. Many of the water management related projects and methods may already be in the planning stages, such as some associated with the CRCA, or projects funded by the roundtable that contemplate multiple phases.⁴⁴¹

Colorado Basin at a Glance

27 projects identified on the Top Projects list meeting environmental or recreational needs

\$132,500,000 in costs identified for **13** projects

21,472 acre-feet of development for environmental or recreational needs identified by **3** projects

Gunnison River Basin

The Gunnison Basin Roundtable identified two basin goals that address environmental and recreational water needs and then identified projects and methods within the basin that could assist in meeting those needs.⁴⁴² The roundtable compiled this inventory of projects and methods through outreach within the basin and participation by stakeholders in the BIP process. The roundtable also convened a group of environmental and recreational advocates, including staff from state and federal agencies, to provide input and assist in identifying focus reaches. As part of the BIP process, the roundtable approved the use of “project summary sheets,” used to break down elements of projects and methods such as project proponent, project cost, and effectiveness at meeting basin goals.⁴⁴³

In organizing its projects and methods inventory, the roundtable established three tiers of projects, with timeline and effectiveness of meeting basin goals as the two criteria for tiering. The basin roundtable also identified 29 target stream reaches within the basin as areas where environmental and recreational projects and methods could be beneficial. While identifying potential projects and methods, the roundtable called out a series of ongoing efforts involving environmental protections and monitoring that help to maintain these attributes within the basin.

The Gunnison Basin Roundtable defined Tier 1 projects and methods as those whose implementation is likely feasible by 2025 and do an excellent job of meeting basin goals.⁴⁴⁴ 18 of the 49 projects classified as Tier 1 are associated with Basin Goal #5: “quantify and protect environmental and recreational water uses.”⁴⁴⁵ These projects are mostly focused on improving or restoring stream channels within the aforementioned target stream reaches, or improving native trout populations. Many projects identified as Tier 1 projects are multi-purpose projects that include an environmental or recreational benefit. The roundtable also identified 22 projects as meeting Basin Goal #7: “Describe and encourage the beneficial relationship between agricultural and environmental and recreational water uses.”⁴⁴⁶ These projects are chiefly multi-purpose projects for agricultural uses with environmental and recreational benefits identified, in line with this basin goal.

Gunnison Basin at a Glance

30 projects identified meeting environmental or recreational needs

\$427,848,100 in costs identified for **23** projects

21,472 acre-feet of development for environmental or recreational needs identified by **10** projects

The Gunnison Roundtable also established some measurable outcomes for its environmental and recreational goals that are based in project implementation. Moving forward, the roundtable aspires to develop 10 projects from the list of recommended solutions by 2030. Additionally, the roundtable included a more comprehensive inventory of environmental and recreational projects as a method in the list of recommended solutions, and hopes to see this “Identification and Inventory” completed by 2020.⁴⁴⁷

North Platte River Basin

The North Platte Basin also had two primary goals related to environmental and recreational uses and needs.⁴⁴⁸ The BIP process was informed by the public outreach and education process that the roundtable had been doing up to that point, engaging stakeholders within the basin as well as a more technically-based outreach to identify specific projects and methods. Similar to the Gunnison BIP, the North Platte Basin Roundtable identified one goal associated with the maintenance of healthy rivers and wetlands, and one geared toward the nexus with agricultural water use. For both of these goals, the BIP’s measurable outcomes are based on project implementation, with an inventory of potential projects and methods that serve as “recommended solutions.”⁴⁴⁹

North Platte Basin at a Glance

55 projects identified meeting environmental or recreational needs

6,226 acre-feet of development for environmental or recreational needs identified by **3** projects

The projects and methods identified in the BIP complement the roundtable’s previous work, which prioritized environmental and recreational attributes within the basin. The roundtable applied the previous prioritization of attributes to the inventory of recommended solutions, and set out a process for identifying locations where these needs are not being met, and finding solutions. Measurably, the roundtable plans to develop three projects from the inventory of solutions by 2020.⁴⁵⁰ Regarding the goal of supporting environmental and recreational benefits through

agricultural projects, the roundtable plans to complete at least two multi-purpose projects by 2025.⁴⁵¹

In its inventory of recommended solutions, the roundtable identifies 50 environmental and recreational projects. Of these projects, 37 are classified as restoration of wetlands, riparian or stream projects.⁴⁵² These projects identify specific species for protection and habitat restoration, and many are also associated with water quality or watershed health. The North Platte Basin Roundtable has a particular emphasis on wetlands protection and restoration, so amphibians and waterfowl are identified as direct beneficiaries of implementation projects. Ten of the basin projects are focused on habitat restoration through projects that will improve livestock grazing management through fencing. The focus in this basin, as is evident by its goals and implementation based outcomes, is multi-purpose projects and methods.

Through implementation of these projects and methods, the roundtable hopes to accomplish incremental increases in recreational activities within the basin. Specifically, the basin aspires to a 5 percent increase in waterfowl hunting and viewing days by 2020, as well as a 5 percent increase in fishing user days in the same time period.⁴⁵³ Moving forward, the basin will use its existing prioritization system to evaluate funding for projects and methods in this inventory of recommended solutions.

Rio Grande River Basin

The Rio Grande Basin Roundtable, like others around the state established a set of basin goals, and then examined potential projects and methods with these goals in mind. The roundtable compared its basin goals with basin needs and came up with a multi-purpose focus, as all basin goals had a nexus with environmental and recreational needs.⁴⁵⁴ The roundtable gathered and consolidated projects and methods through its public outreach process, and through the work of subcommittees led by the BIP Steering Committee. The roundtable has identified 29 projects and methods to date, described in detail in "Project Fact Sheets," which were preliminarily evaluated by basin goals.⁴⁵⁵

Rio Grande Basin at a Glance

58 projects identified meeting environmental or recreational needs

\$129,674,531 in costs identified for **24** projects

4 stream miles of protection for environmental or recreational needs identified by **3** projects

The roundtable assessed the projects and methods identified in the BIP as multi-purpose projects, with 28 identifying some nexus with environmental and recreational needs.⁴⁵⁶ Additionally, the basin compiled a list of additional projects and methods that may merit future consideration, but were not considered in this iteration of the BIP because of time constraints. This additional section identified 19 projects and methods that would meet an environmental or recreational need, often as part of a multi-purpose project.⁴⁵⁷

In keeping with the goals and measurable outcomes of this roundtable, many of the identified projects and methods have a focus on riparian restoration and watershed health. Projects that fall into these categories include projects intended to improve fish habitat, restore headwaters, and result in comprehensive watershed planning. Identified storage projects are viewed as potential sites for wildlife habitat and recreational opportunities, such as angling and boating. Other projects

and methods fall into the category of water management, with studies planned on hydrology within the basin, examinations of post-fire conditions, and potential streamflow optimization.

Moving forward, the roundtable has estimated costs for 25 of the 29 projects that were examined in Project Fact Sheets. These 25 projects total an estimated financial need of more than \$218 million through the year 2020.⁴⁵⁸ As the roundtable moves forward with the basin planning effort, it will explore funding avenues, and may refine the list of identified projects and methods. The roundtable will do more analysis of the supplementary list of projects and methods, and as it measures these potential recommendations against basin goals, may prioritize some of them. Similar to the Colorado Basin Roundtable, the Rio Grande Roundtable has identified the need to fill information gaps regarding environmental and recreational needs and to find ways to better understand how water may be managed to maintain and protect these attributes. The BIP provides a list of projects and methods that would address these information gaps, and provide guidance to the roundtable as it moves forward on project funding and implementation.⁴⁵⁹

South Platte River Basin (Including Metro)

The joint BIP prepared by the South Platte Basin and Metro Roundtables required a large amount of outreach throughout the basin, as the most populous area in Colorado. The roundtables chose “Protect and enhance environmental and recreation attributes,” as an area of focus when looking to future water needs in the basin. Additionally the roundtable identified a series of measurable outcomes to meet the basin Environmental and Recreational Goal: “Fully recognize the importance of, and support the development of environmental and recreational projects and multipurpose projects that support water availability for ecologically and economically important habitats and focus areas.”⁴⁶⁰

South Platte/Metro Basin at a Glance

75 projects identified meeting environmental or recreational needs

The South Platte/Metro BIP highlights example projects throughout the basin that are consistent with the above environmental and recreational Goal. These example projects are listed by basin sub-region, with mapping and analysis provided that demonstrates key attributes in those areas. The South Platte/Metro team, similar to other basins, chose to create an inventory of projects and methods to serve as a suite of options for fulfilling these nonconsumptive measurable outcomes. A great deal of the projects listed for environmental and recreational projects came from the SWSI 2010 Nonconsumptive Needs Assessment, many of which have been completed. Beyond these identified projects, the roundtables also created an inventory of “Additional Identified Environmental and Recreational Projects.”⁴⁶¹ The roundtables identified these projects through the public outreach process, through proponent submission, or as active projects in progress that the roundtables chose to identify as steps toward meeting the nonconsumptive measurable outcomes.

Beyond the inventory of SWSI and additional environmental and recreational projects, the roundtables also identified specific examples of projects that they believe meet their measurable outcomes, and would be good models to follow in the future. Existing multi-purpose projects throughout the basin were specifically highlighted in line with goals and measurable outcomes. These goals focus on endangered and threatened species, the economic value of environmental and recreational uses, and the sustainability of water-dependent areas. Following these goals, the

roundtables categorized many of projects identified beyond the SWSI Needs Assessment as wetlands restoration, riparian restoration, and stream habitat projects. Measurably, the roundtables identified the recovery of key species of trout and native plains fish as important. Serving as a snapshot of the current state of affairs in the basin, this list identifies projects that are proposed, planned, completed, and ongoing.

The BIP also includes an analysis of the benefits to environmental and recreational needs that multi-purpose projects can provide. Examples include the potential for installation of environmentally-friendly passages after flood events, coordinated reservoir operations, and recharge projects.⁴⁶² Moving forward, the roundtables will continue to identify projects and methods that match up with their identified measurable outcomes, and seek to identify projects that may meet multiple needs.

Southwest River Basin

The Southwest Basin Roundtable completed an extensive public outreach process, to provide a comprehensive update to the SWSI 2010 IPP list. Through a series of public meetings, newspaper articles, and conversations with water management entities within the basin, the roundtable created a complete inventory of new IPPs within the basin. Additionally, the roundtable identified “Conceptual IPPs,” which have no active sponsor, but are ideas for projects and methods within the basin that may conform to basin goals and measurable outcomes.⁴⁶³ The Southwest Basin Roundtable, similar to the Rio Grande, evaluates any project or method for potential multiple uses and benefits, so about 50 percent of the IPPs are primarily meeting potential environmental and recreational needs.⁴⁶⁴

Southwest Basin at a Glance

72 projects identified meeting environmental or recreational needs

\$30,000 in costs identified for **1** project

202 stream miles of protection for environmental or recreational needs identified by **9** projects

The goals identified by the roundtable specifically identify the benefit to statewide and local economies that environmental and recreational values provide. The roundtable’s measurable outcomes include the maintenance, protection, and enhancement of these uses, as well as species recovery and watershed health. The inventory of projects and methods lists 67 environmental and recreational projects.⁴⁶⁵ Additionally, the inventory identifies projects that pertain to invasive species removal, native revegetation, hydroelectric projects, natural disaster mitigation, habitat protection and restoration for trout and warm water fish, appropriation of instream flows, habitat assessments, and fish passage projects.

The roundtable identifies representative environmental and recreational IPPs within the text of the BIP. These example projects provide a look at the type of implementation of environmental project and method implementation that is planned or ongoing within the multiple subbasins of the Southwest. In line with the basin’s measurable outcomes relating to the “condition and natural function of streams, lakes, wetlands, and riparian areas,” riparian restoration projects are planned for key reaches of the La Plata, the Dolores, the Navajo, and the San Juan rivers.⁴⁶⁶ On the Florida River, livestock fencing is identified as a means to protect a riparian buffer zone.

Moving forward, the basin will continue to consider all proposed IPPs equally, and evaluate each one for potential multiple uses and benefits. In the text of the BIP, the roundtable considers the opportunities for funding availability, and explores the concept of “bundling” a package of proposals, and how such an approach may be a way to make the most of limited funding.⁴⁶⁷ The Southwest Basin Roundtable, similar to the Rio Grande and Colorado, identifies the data gaps in environmental and recreational water needs as a priority moving forward. The roundtable discusses identification and evaluation of gaps in this body of knowledge, and believes that by addressing these gaps, planning for the water supply future of the basin will be more reliable and project implementation can be made more efficient.

Yampa/White/Green River Basin

The Yampa/White/Green Basin Roundtable drew from two different sources to compile an inventory of projects and methods within the basin. First, the roundtable conducted an extensive outreach process, with several public meetings, information in local publications, and surveys. Also, the roundtable had previously begun the Projects and Methods Study, which identifies projects and methods within the basin, as well as comparing certain IPPs against potential future hydrological scenarios.⁴⁶⁸

Yampa/White/Green Basin at a Glance

22 projects identified meeting
environmental or recreational needs

\$5,050,000 in costs identified for **4**
projects

371 stream miles of protection for
environmental or recreational needs
identified by **16** projects

The roundtable identified two main inventories of projects with an environmental and recreational nexus. Many of the projects and methods listed in the inventory of “Current M&I, SSI, Agriculture, and Multi-Purpose IPPs” have an identified or potential benefit for environmental and recreational needs, some of which were modeled.⁴⁶⁹ Additionally, some of the identified projects are the subject of ongoing feasibility studies that could potentially identify environmental and recreational benefits to be realized through project implementation. The roundtable identified a collection of projects with primarily environmental and recreational benefits, drawn from interviews and information provided by basin stakeholders. Most of these projects and methods are located within focus areas identified by the roundtable. This collection identifies 18 projects and methods. Several of these projects have a completion date before 2020, with others classified as ongoing through 2020.⁴⁷⁰

The list of Environmental and Recreational Identified Projects and Processes focuses heavily on the improvement of existing river conditions to restore and improve environmental and recreational attributes. Several projects identify specific reaches to modify for the benefit of endangered fish or for recreational access. Other projects seek to restore and preserve the natural state of the river for watershed health and erosion control. Other proposed methods would study potential solutions to identified challenges such as flow regimes for endangered fish or potential augmentation of instream flow shortages. However, the roundtable emphasizes that the current inventory is not exhaustive, and that other projects and methods will be necessary to fully address the environmental and recreational needs located within focus segments or otherwise. As planning efforts continue within the basin, the roundtable will identify additional projects and methods to meet these needs.

Like other basin roundtables, the Yampa/White/Green BIP stresses the need for accurate information and analysis of data gaps for environmental and recreational needs. To that end, the roundtable plans to use studies and modeling efforts already completed or underway to fully assess the effects of projects and methods. The roundtable will use these analyses to determine which type of project or location would be the most beneficial regarding stream conditions and hydrologic impact.

IBCC Actions

In 2013, the IBCC developed the “No and Low Regrets Action Plan” to implement environmental and recreational projects and methods. This strategy outlines what should be carried out in the near term statewide. The IBCC reached consensus on the need to implement the actions summarized in Table 6.6-1 regardless of the future scenario.

Table 6.6-1: Completed, Ongoing and Potential Future Actions	
Completed and Ongoing Actions	Potential Future Actions
<ul style="list-style-type: none"> • Implement Endangered Species Act recovery programs • Implement basin nonconsumptive projects • Develop draft Nonconsumptive Toolbox • Put Wild and Scenic alternatives in place • Implement the CWCB Instream Flow Program • Implement Colorado Watershed Restoration Program • Implement Species Conservation Trust Fund • Implement CPW Management Plans 	<ol style="list-style-type: none"> 1) Develop statewide goals and measurable outcomes to be considered for incorporation into BIPs <ol style="list-style-type: none"> a) Develop goals and measurable outcomes for federally-listed endangered and threatened species b) Develop goals and measurable outcomes for imperiled species c) Develop goals and measurable outcomes for economically important nonconsumptive uses d) Develop goals and measurable outcomes for multi-purpose projects and methods 2) Pursue projects and methods to meet nonconsumptive needs as part of the BIPs <ol style="list-style-type: none"> a) Develop basinwide goals b) Develop measurable outcomes c) Identify needs and opportunities d) Use the decision process to determine projects and methods 3) Track nonconsumptive projects and methods <ol style="list-style-type: none"> a) Conduct nonconsumptive surveys and analysis b) Create web portal c) Use existing database d) Use the Basin Needs Decision Support System 4) Develop incentives, including funding for projects and methods in the nonconsumptive focus areas <ol style="list-style-type: none"> a) Assess funding needs b) Target existing funding sources and programs to provide enhanced levels of support for implementation of nonconsumptive needs. c) Explore additional incentives, including funding options 5) Develop environmental metrics that can be used to evaluate future projects (to be considered in the new supply discussions) <p>Manage and improve storage, infrastructure, and reservoir operations to benefit environmental and recreational values [see section 6.5]</p>

Actions

To support a strong environment that includes healthy watersheds, rivers and streams, and wildlife, as well as a robust recreation and tourism industry, several actions are necessary:

1. **Technical work:** As part of the next version of SWSI, the CWCB, in consultation with the basin roundtables, will conduct additional technical work associated with the environmental and recreational focus areas to better determine the levels of existing protections, and where additional projects and methods should be focused.
2. **Near-term projects and methods to address high priority needs:** The CWCB will work with CPW, the basin roundtables, and other relevant agencies to establish and achieve measurable outcomes for federally and state listed endangered and threatened species, imperiled species, and economically important water-based recreational uses by developing a plan within the next three years that compiles and develops near-term projects and methods that address these high priority needs, including projects identified in the BIPs. This work will build on the work of the basin roundtables and the SWSI, including the work done in Action 1 above. At the same time, the CWCB will continue to support the strategic implementation of currently identified projects with technical and financial assistance.
3. **Common metrics:** In coordination with other state agencies, basin roundtables, and other stakeholders, the CWCB will develop common metrics for assessing the health and resiliency of watersheds, rivers, and streams.
4. **Watershed master plans:** As indicated in Section 7.1, to maintain watershed health, the CWCB will work with watershed and other stakeholder groups toward a long-term goal of developing watershed master plans for every large watershed area. The CWCB will encourage and support capacity in areas that currently do not have watershed groups or other broad local stakeholder groups.
5. **Stream management plans:** To promote healthy watersheds, rivers, streams, and wildlife, the CWCB encourages and will work with basin roundtables and other stakeholder groups to develop stream management plans for priority streams identified in a BIP or otherwise as having environmental or recreational value. As part of this work, the CWCB will provide guidelines and templates for developing stream management plans, and will conduct ongoing analyses through the SWSI. To ensure continued planning and implementation in this context, the CWCB will explore additional funding sources, in addition to that provided in the 2015 CWCB Projects Bill.
6. **Incorporation of drought & climate change:** The basin roundtables and the CWCB will incorporate the potential effect of drought and climate change on environmental and recreational attributes into the BIPs and the next update of the SWSI.
7. **Multi-purpose projects:** To support the development of multi-purpose projects and methods, the CWCB will work with the basin roundtables and other stakeholders on an integrated approach to understanding how environmental and recreational projects and methods can interact with municipal, agricultural, and industrial projects and methods to achieve multiple benefits. The CWCB will strategically support the implementation of BIP identified multi-purpose, projects and methods that help meet environmental, recreational, agricultural and community water needs with state financial and technical resources, taking into consideration locally identified geographic and/or seasonal gaps. This will include establishing priorities in Colorado's grant and loan programs for multi-purpose projects and methods. Working with the basin roundtables and BIPs, the CWCB will also coordinate with

project sponsors to explore and support opportunities to increase benefits to environmental and recreational values associated with existing and planned storage and infrastructure.

8. **Proactive implementation of existing programs:** The CWCB, other state agencies, basin roundtables, and other interested stakeholders will continue to support and implement state programs that benefit environmental and recreational attributes, such as the Colorado Watershed Restoration Program, Instream Flow and Natural Lake Level Program, Wild and Scenic Rivers Act Alternatives Fund, and CPW's Wetlands for Wildlife Program. The DNR and its agencies will institute policies, criteria, and programmatic approaches to proactively developing projects and methods that strategically address important aquatic, riparian, and wetland habitats.
9. **Continued support of Endangered Species Act activities:** The CWCB, CPW, and water users will continue to support and participate in collaborative approaches to Endangered Species Act issues, including recovery programs, cooperative agreements, and other efforts to prevent listings and promote the sustainability of endangered, threatened and imperiled aquatic and riparian-dependent species and plant communities.
10. **RICDs:** The CWCB will continue to support local governments on recreational in-channel diversions through technical consultation and funding where appropriate.
11. **Funding:** As discussed in Section 9.2, the CWCB will work with appropriate entities to strengthen funding opportunities for environmental and recreational projects, including funding for long-term monitoring and maintenance of such projects, by:
 - a. Coordinating current funding
 - b. Assessing funding needs
 - c. Exploring additional funding opportunities

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